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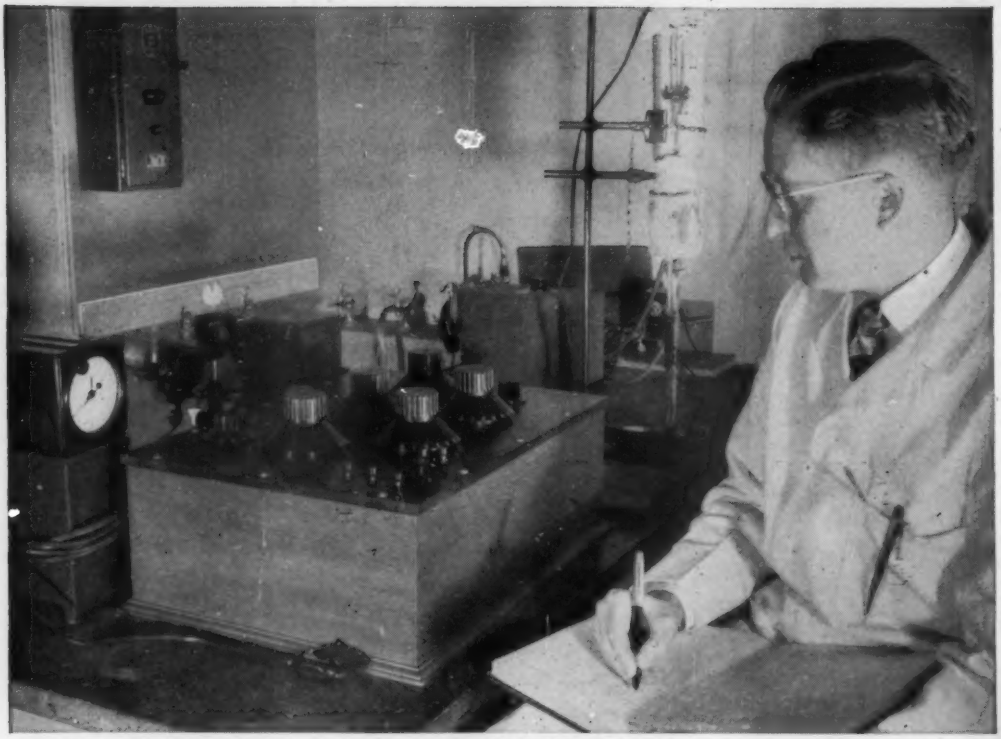

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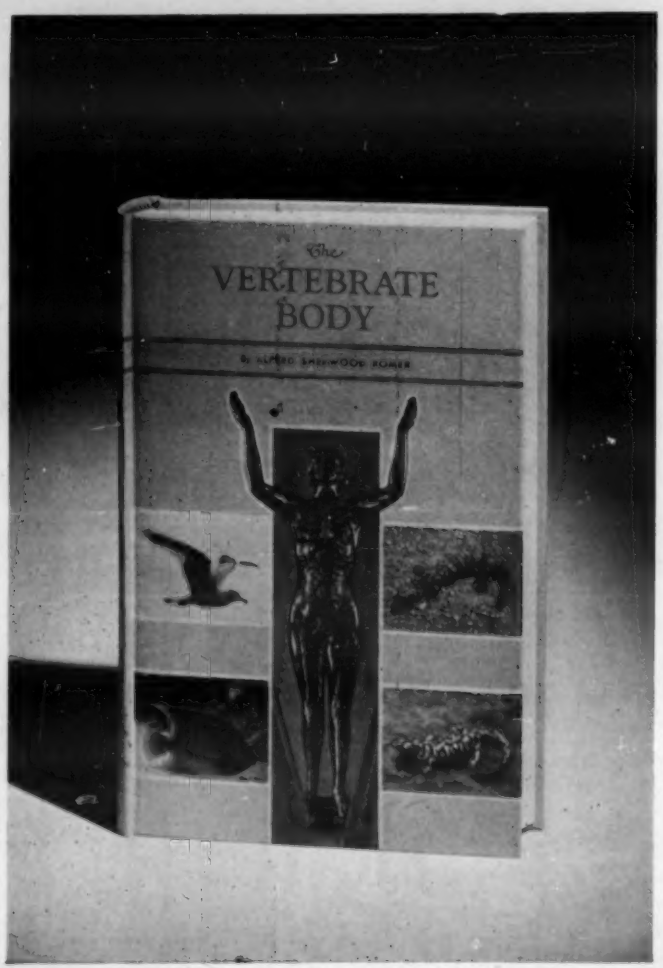

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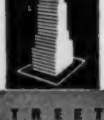
McGRAW-HILL  **BOOK COMPANY, Inc.**

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Growth Rate of Industrial Research

IN 1950 industry spent in the neighborhood of one billion dollars for research and development, and employed about 165,000 scientists, engineers, and technical assistants. This was more than twice the number employed in 1940 and nearly ten times greater than in 1927. During the past two decades the expansion of research was quite pronounced in the chemical and petroleum industries and, since 1940, in aircraft and electronics. On this evidence alone, plus the continuous stream of new products that have been coming out of our research laboratories, it would certainly appear that the health of our industry-supported science is very good indeed. But is it?

One way to examine progress in industrial research is to compare the rate at which laboratory personnel has been expanding for the past twenty years. When this is done, on the basis of data assembled by the National Research Council, it is found that the average annual rate of growth of research staffs was nearly twice as large in the depression-ridden thirties as in the prosperous forties. Similar trends may be observed in some of our most research-minded industries, such as chemicals and petroleum. In some of the newer industries, however, such as electronics and aircraft, the reverse is true.

Another way of looking at the growth of industrial research is by comparing it with changes in production activities. Although there was a continuing and rapid growth of laboratory personnel in relation to production workers, the rate of this growth was somewhat slower in the 1940s than in the preceding decade. The ratio of laboratory personnel per 10,000 production workers engaged in the chemical industries, for instance, grew by about 12 per cent per year in the 1930s and by only 9 per cent in the 1940s. In the petroleum industry the rate of growth was 50 and 30 per cent, respectively.

Not only was the rate of increase in total laboratory personnel slackening during the forties as compared with the thirties, but the composition of laboratory staffs changed. Perhaps it was indicative of better organization of research work and more efficient utilization of scientists that, in 1950, professional researchers represented a smaller proportion of total staffs than a decade earlier. Percentagewise the employment of chemists, physicists, and metallurgists declined, whereas that of engineers increased substantially. In addition to shortages of certain types of researchers during the war boom, a change in emphasis seems to have taken place—from the more fundamental work of the thirties to the more practical engineering developments during the war and postwar years.

From these trends it would appear that our industries have been drawing from the reservoir of previously accumulated knowledge at a faster rate than they have been replenishing, much less augmenting, it by means of new and more fundamental investigations. Therefore, if these trends are diagnostic of the general health of our industry-supported science, there is cause for concern.

When a business executive finds that the rate of growth in his sales is slowing down, he becomes quite concerned and looks for remedies. So it should be with science.

When, in an important segment of our economy, the growth of research staffs suffers deceleration, and the withdrawals from the fund of accumulated knowledge become greater than the deposits, it would seem wise to expand the training programs and speed up the tempo in developing new researchers. Surely this cannot be done by skimping on funds for the National Science Foundation, as the Congress has recently done.

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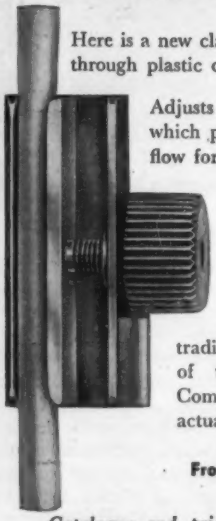

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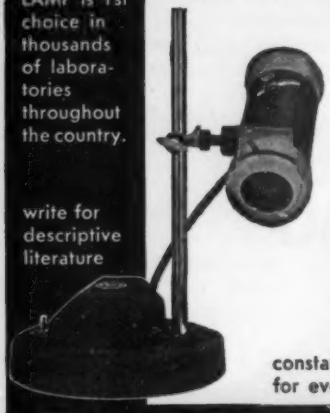

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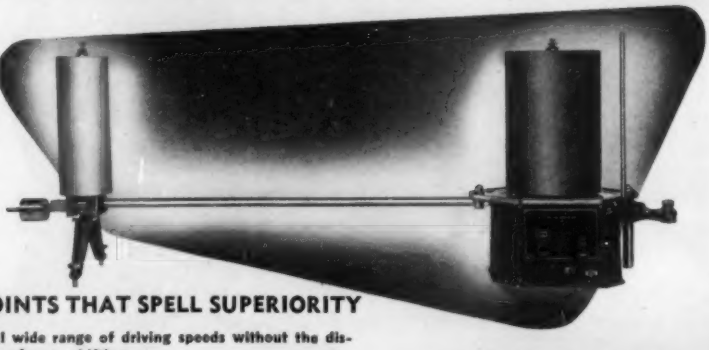

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Lamont Natural Radiocarbon Measurements, I

J. Laurence Kulp, Herbert W. Feely, and Lansing E. Tryon
Lamont Geological Observatory (Columbia University), Palisades, New York[1]

THE DISCOVERY OF THE CARBON 14 method of age determination by W. F. Libby and co-workers (*1–4*) has so many potential applications in geology, anthropology, archaeology, oceanography, and meteorology that the development of several laboratories equipped to make the necessary measurements is imperative. About a year ago the construction of the requisite facilities was undertaken at the Lamont Geological Observatory. During the first year considerable time was spent on building, calibrating, and improving existing techniques. The detailed description of the experimental procedures used in this laboratory will appear elsewhere (*5*). Since several institutions are setting up natural radiocarbon programs and will have a succession of papers reporting dates and measurements that will be of interest to scientists in many fields, it seems desirable to develop the titles in such a way that cross references will be unambiguous. To that end

[1] Lamont Geological Observatory Contribution No. 49.

TABLE 1

KNOWN SAMPLES

Sample No.	Description	Date	Net cpm
40	Anthracite	1/ 2/51– 1/ 4/51	+0.15 ±0.12
45	"	3/15/51– 3/16/51	−0.31 ±0.25
46	"	7/ 5/51– 7/ 7/51	−0.04 ±0.10
54	"	9/17/51– 9/21/51	+0.10 ±0.29
54′	"	9/24/51– 9/28/51	+0.013 ±0.093
57	"	10/20/51–10/22/51	−0.08 ±0.30
			Av = −0.01 ±0.06
43	Modern wood (pine)	3/28/51– 3/31/51	6.17 ±0.07
43′	" " (")	5/18/51– 5/20/51	6.05 ±0.11
49	" " (maple)	8/ 3/51– 8/ 5/51	5.89 ±0.13
49′	" " (")	8/14/51– 8/16/51	6.073 ±0.126
52	" " (oak)	9/24/51– 9/28/51	5.986 ±0.081
52′	" " (")	9/19/51– 9/23/51	6.089 ±0.063
			Av = 6.07 ±0.05
30	Modern clamshells	4/19/51– 4/21/51	6.60 ±0.20
30′	" "	4/29/51– 4/29/51	6.63 ±0.25
30″	" "	5/ 3/51– 5/ 4/51	7.08 ±0.20
39	" "	2/23/51– 2/27/51	6.42 ±0.17
39′	" "	2/27/51– 3/ 1/51	6.95 ±0.15
			Av = 6.72 ±0.10

		Net cpm	Expected age (yr)	C^{14} age (yr)
110 Series	Bikini Lagoon samples submitted by K. O. Emery from Core *Bik. 224* from Lat. 11° 35.6′ N, Long. 165° 30.1′ E, 23 fathoms, about 2½ miles into the lagoon from Bikini Island. Material largely Halimeda debris. The rate of deposition was estimated at about 1 cm/yr on geologic evidence.			
110B	2″– 6″ depth	6.68 ±0.13	5–15	< 100
110C	6″–10″ "	6.74 ±0.12	15–25	< 100
110D	10″–15″ "	6.70 ±0.20	25–40	< 100
		Av = 6.70 ±0.10		
108A	Sequoia trunk in Am. Mus. of Nat. Hist., clean borings in growth rings between year A.D. 1057 and A.D. 1087. Submitted by Junius B. Bird.			800 ±600
				900 ±200
				1030 ±200
				900 ±200
			880 ±15 Av	930 ±100
108B	Sequoia trunk as above, rings A.D. 570–A.D. 578.			1520 ±170
				1300 ±200
			1377 ± 4 Av	1430 ±150

we propose that the institutional name occur somewhere in the title.

This paper reports the carbon 14 measurements made on various natural, carbon-bearing materials of geological and archaeological interest. The halflife of carbon 14 used is 5,568 years, and the specific activity for modern wood of 15.1 dpm/g determined by Libby (*6*). The errors reported are standard deviations obtained from the counting data. It will be apparent from the facts given below that the counting error is probably the dominant one.

Table 1 gives the data on the known samples used for calibration. After a contamination problem encountered early in the work, the anthracite specimens have remained "dead" within the experimental error. The modern wood values (av 6.07 ± 0.05 cpm) give the base for any age ratio. The samples from the Bikini Lagoon were taken prior to the atomic explosions. They not only prove the high rate of carbonate sedimentation within such lagoons as compared to the open ocean (1 cm/1,000 yr) but give activities equal to that obtained for modern shells. Assuming 14.70 dpm/g for wood, these data give 16.20 ± 0.15 dpm/g for modern carbonate, in agreement with Libby for several modern shell samples. Agreement between the expected and actual age of the other samples appears satisfactory.

Table 2 lists the dates obtained for various archaeological specimens. Samples 115 and 116B provide interesting interlaboratory calibration, since similar material was run in Libby's laboratory.

TABLE 2

ARCHAEOLOGICAL SAMPLES

Sample No.	Description	Age (yr)
113	*Mayan lintel:* Wood (Zapote) taken from carved Mayan lintel from structure 10, Tekal, Guatemala. Am. Mus. Nat. Hist., submitted by Junius B. Bird. Carved date on lintel: 9.15.10.00 in the Mayan calendar which, according to the Goodman-Thompson correlation, would be June 30, A.D. 741. According to the Spinden correlation, this would be Aug. 30, 481. Wood has about 30 years' growth. Hence expected date is (1210–1240) +, Goodman-Thompson or (1470–1500) +, Spinden. Comment: Looks like Spinden date.	1600 ± 200 1400 ± 150 Av $\overline{1470 \pm 120}$
115	*Paracas:* Prehistoric cotton cloth, Mummy 114 (Bundle B 1946-14, Am. Mus. Nat. Hist.) Paracas Necropolis Period, Peru. This specimen is of same cultural level but need not be same age as Libby's No. 271, which gave (2257 ± 200).	1850 ± 250 1550 ± 200
104A	Signal Butte I horizon (levels II and III not represented). Charcoal collected by W. D. Strong and John Champe, Nov. 1950, from lowest level (A) in I; below limited sterile split (B), and upper I occupation zone (C). Lot I—S.B. IA } one sample, Lot II—S.B. IA } two counts,	3420 ± 300 3450 ± 150 Av 3445 ± 120
104B	Signal Butte I horizon, three lots combined, Lot III S.B. IC (above split B) and Lots IV and V—S.B. I in an area where there was no split in strata I. Charcoal from C insufficient for test, hence the combination. Lot III—S.B.I.C. Lot IV—S.B.I. (no split) Lot V—S.B.I. (no split) Comment: Younger than commonly accepted. See Strong (*7*), estimate of *ca* 6065 B.C.; and Strong (*8*), estimate of *ca* 2000 B.C. However, Bliss (*9*) estimates S.B.I.C. *ca* 1050 B.C.	2950 ± 200
114	*Jaketown:* Carbonized plant material collected by J. Ford, field designation 20–0–1, 3 miles north of Belzoni, Miss., prepottery.	2400 ± 150 2300 ± 100 Av $\overline{2350 \pm 80}$
112C*	*Shagak Bay:* Wood from Aleut midden, north shore of Shagak Bay. Material in place of basal debris of midden at about 3′ above level of rare storm wave activity of present sea. Land has not been lower with respect to sea level for at least X years where X = age of wood.	660 ± 100
112E*	*Clam Lagoon:* Clamshells from Aleut midden on north part of sand pit enclosing clam lagoon. Comment: Aleut culture appears over longer time interval than anticipated. Libby obtained 3020 on one Aleut site.	4620 ± 100 4610 ± 160 4530 ± 150 Av $\overline{4600 \pm 80}$
116B	*Huaca Prieta No. 2.* Charcoal from botton of deposit. Dates from near beginning of occupation of the first agricultural prepottery culture. This should be similar material to Libby's No. 598, which gave 4298 ± 230. The agreement is reasonably satisfactory, since only one determination was made in each laboratory.	3650 ± 400

* Nos. 112C and 112E submitted for geological interpretation; no critical archaeological data available.

Table 3 gives the radiocarbon measurements on several samples taken from deep ocean water and deep-sea cores. In each case the carbon was extracted from the sample as carbon dioxide. The deep ocean water sample suggests that the gross oceanic circulation from the arctic surface along the bottom to the equator may be measurable. Further sampling of ocean water at various depths is in process.

TABLE 3

OCEAN SAMPLES

Sample No.	Description	Activity in epm/g	Apparent age (yr)
100 AB	CO_2 extracted from ocean water taken at 4,100-m depth near Lat. 38° 30′ N, Long. 68° 10′ W. Comment: This was a much smaller sample than usual and had a higher ash correction, so that the result must be considered tentative.	6.31 ± 0.20	200 ± 100
105 series	(Submitted by D. Ericson) Core A-164-#38: $CaCO_3$ extracted from various core depths. This core shows coarse debris and graded bedding, apparently representing recent deposition of older material by mass movement.		
	105A 0–12 cm		17,000 ± 900 16,100 ± 1300 16,600 ± 700 Av 16,600 ± 500
	105B 88–92 cm		> 25,000
	105C Cutting edge shell fragments		> 25,000
107 series	(Submitted by D. Ericson.) $CaCO_3$ from Core A152–118 North Atlantic. The lithologic character of the core from 100–350 cm suggests slumped material from the Mid-Atlantic Ridge.		
	107A 84– 92 cm		14,100 ± 800
	107B 196–204 cm		> 25,000
	107C 396–404 cm		16,700 ± 900 16,400 ± 800 Av 16,500 ± 700
	$CaCO_3$ from Core #C-10-14, flats along Hudson Canyon. Sharp lithologic break at 75 cm. Sediment below probably underwent more rapid deposition.		
			14,400 ± 700 14,100 ± 600
	107D 19– 29 cm		Av 14,200 ± 500
	107E 126–143 cm		20,000 or older
	$CaCO_3$ from Core #C-10-5 Lithologic evidence indicates much more rapid rate of deposition below 10 cm.		
	107F 0– 10 cm		5850 ± 250
	107G 149–160 cm		19,000 ± 2200 21,100 ± 1800 Av 19,600 ± 900

The activity present in the top 12 cm of Core A-164-38 is probably due to the mixing of some fine recent calcium carbonate mud with the older material as the latter moved down the slope. A-152-118 shows the presence of slumped sediment between two normal sedimentation sequences.

Table 4 shows the results for a variety of geological samples. Probably the most important is the cedar log from greater Bermuda 111A, which gives an age for the rise in sea level at the end of the Wisconsin stage. This coincides closely with dates obtained by Libby for the termination of the Wisconsin in North America (Two Creeks formation 11,400) and Europe (Alleröd, 11,050; Irish mud, 11,300; and Godwin, 10,850). The sample of peat (111B) representing a higher water stage indicates that the time for the complete melting of the continental glacier must have been on the order of 6,000 years, in agreement with the findings of DeGeer, which were based on varve counts for the retreat of the continental glacier in Scandinavia.

TABLE 4

GENERAL GEOLOGY SAMPLES

Sample No.	Description	Age (yr)
111A	*Bermuda:* Fossil cedar log dredged from entrance to St. George's Harbor. This is representative of widespread cedar forest of Greater Bermuda, which now lies under 10′–30′ of water and 10′–20′ of mud. Presumably rise in sea level at end of Wisconsin killed this forest. Comment: Consistent with Two Creeks date of Mankato. Samples from Wisconsin, Europe, and now Bermuda concur on end of last glacier period at about 11,000 years ago.	11,500 ± 700
111B	*Bermuda peat:* Peat obtained from dredging noted above, but stratigraphically above cedar forest. Comment: Suggests slow rate of sea level rise equivalent to rate of retreat of Wisconsin continental glacier.	7600 ± 600 6700 ± 200 Av 6900 ± 150
102A	*La Soufriere:* Charred wood under last great eruption of La Soufriere, island of Guadeloupe. Submitted by E. Bruet, Sorbonne. Dr. Bruet had estimated the eruption to have taken place about 900 years ago on stratigraphic grounds. No tradition is available for a precise historical check.	550 ± 150
103B	*Boothbay:* Clamshells from a hole dug in the geographic center of the flat in Sagadahoc Bay, Maine, where they occur in marked concentration in a layer 26″ below present surface. The buried layer represents an interval of widespread erosion that was catastrophic for the clam population. Precommercial clam digging.	1000 ± 500 1200 ± 150 Av 1190 ± 140
112B	*Henry Mountains:* Block of wood from alluvial deposit in Henry Mountains Region, Utah. From a study of tree rings of	< 100

TABLE 4—(*Continued*)

Sample No.	Description	Age (yr)
	trees growing on alluvium, the deposit is assumed older than A.D. 1050. Comment: Wood is either recent or contaminated. It may not have been *in situ*.	
	Alaskan Samples	
101A	*Anchorage:* Peat from north end of Anchorage International Airport. Sample from lower foot of an 8′ peat exposure. The peat rests on a blue clay. Submitted by E. B. Eckel. Thought to be old but post-Wisconsin.	5340 ± 300
101B	*Eagle River:* Coaly peat from an exposure along Eagle River north of Anchorage. This peat is about 10″ thick and is interlayered with blue clay. It is overlain by late Wisconsin till, and overlies gravel. Comment: Appears to be Cary-Mankato interstadial.	14,300 ± 600
106C	*Mendenhall:* Large wood sample from beneath gravels and outwash of Mendenhall Glacier, Alaska—represents "inter-fluctuational" forest. Submitted by Maynard Miller.	1790 ± 285
112G	*Etienne:* Basal 3″ of 4′ peat deposit grading up to present vegetation. Behind raised beach ridge in Etienne Valley, at elevation of 60′ above present living seaweed line. Age of sample gives minimum age of aggraded valley floor behind beach ridge, which is now raised above present sea level. Submitted by E. Ingerson.	1750 ± 100

TABLE 4—(*Continued*)

Sample No.	Description	Activity in cpm/g	age (yr)
117J	*Tustemena:* Partially lignitized wood from outwash sands in bluffs on northwest shore of Tustemena Lake, Kenai Peninsula. Submitted by T. N. V. Karlstrom. Comment: Suggests Cary-Mankato interval.		15,800 ± 400

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Columbia University has announced plans for a $22,150,000 Engineering Center. The Engineering Center will combine teaching, research, and practice in engineering and the fundamental sciences, on both undergraduate and graduate levels. Besides the Engineering School, the plans provide for an Institute of Advanced Engineering Science and a Division of Cooperative Research in Engineering which will work with industry on problems having educational value. Of the $22,150,000 required to put the Engineering Center program into effect, $13,650,000 is being sought immediately to provide buildings and equipment, and $8,500,000 will be required subsequently for professorships, fellowships, and scholarships. The Engineering Center will be established at Riverside Drive and 125th St. The first unit, an existing four-story building, has been acquired and is now being remodelled and occupied as it becomes ready. The second unit will be erected as soon as funds are available, the aim being completion no later than 1954, the university's bicentennial anniversary. The center will have a staff of 267 professors, assistants, and research workers, compared with a present staff of 142. Enrollment will be increased as the center develops, from the present 1,061 students to an eventual total of 1,750—750 undergraduates and 1,000 graduate students.

Project Atoll is part of a cooperative program of the Military Geology Branch, U. S. Geological Survey, and the Corps of Engineers, U. S. Army. A field party consisting of F. Stearns MacNeil, F. R. Fosberg, and Theodore Arnow, of the Survey, will conduct a coordinated scientific reconnaissance of a dozen islands in the northern Marshalls. Several of the atolls have never been studied scientifically, and two of them, Taongi and Bikar, are reported to be only slightly altered from their primeval state. The program has been designed to fit into the Atoll Research Program of the Pacific Science Board.

Forrest Shreve: 1878–1950

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FORREST SHREVE was born in Easton, Maryland, on July 8, 1878. He completed his grade and high school training in this small tidewater town, and was graduated from The Johns Hopkins University with the A.B. degree in 1901. He immediately began working toward a Ph.D., choosing to investigate the life history of *Sarracenia purpurea* and becoming deeply interested in the ecology of plants. During the final year of his doctoral training he served as instructor in phanerogamic botany at Cold Spring Harbor and received the Ph.D. degree from Johns Hopkins in June 1905.

During 1905–06 Dr. Shreve held an Adam T. Bruce fellowship as a postdoctoral investigator from The Johns Hopkins University and spent that year, and shorter periods on two later occasions, at the New York Botanical Garden's tropical station at Cinchona, Jamaica. His experiences there gave him an insight of considerable scope into the intricacies of tropical plant ecology. Thirty years later he continued to compare floristic conditions in Jamaica with those occurring along the west coast of Mexico.

For two years (1906–08) Dr. Shreve was associate professor of botany at Goucher College and in collaboration with M. A. Chrysler and F. H. Blodgett devoted much time and effort to a botanical survey of Maryland. This task resulted in the publication of a 533-page report, entitled *Plant Life in Maryland,* under the authorship of the three men.

In 1909 Dr. Shreve married Edith Coffin Bellamy and moved to Tucson, Arizona, to accept an appointment to the staff of the Desert Laboratory of the Carnegie Institution of Washington, a connection he maintained until his retirement in 1947. In 1928 he was placed in charge of the Desert Investigations of the Carnegie Institution and began planning a series of taxonomic and ecological investigations of the floras of all the major desert regions in North America. For four years he felt impelled to work on projects initiated prior to his appointment as head of the Desert Laboratory before devoting his energies to the comprehensive survey of the desert vegetations.

In 1932 he began intensive work on the floristics of the Sonoran Desert, a natural desert region occupying parts of Arizona, California, Sonora, and Baja California. He chose to ignore both state and international boundaries in conducting the study and to recognize instead lines of demarcation drawn by the vegetational assemblages peculiar to, and characteristic of, that particular desert area. He planned to make the observations on the floristics of the region himself, but to enlist others to carry on the taxonomic investigation of its flora. He pushed the project forward with vigor and imagination until gathering war clouds in the late 1930s hampered field, laboratory, and herbarium work. By that time he had accumulated nearly all of the data he needed to complete his account of the vegetational groups he felt he could recognize with assurance. He completed his book covering that aspect of the work, but unfortunately was not permitted to see it through final publication.

Forrest Shreve was a man of quiet demeanor, a bit difficult to know well, but loyal to his friends, kindly in his support, and possessed of a great patience with his associates and employees. He early developed, and retained until his death, an interest in the publication of papers and reports dealing with plants and in several societies whose members shared his own enthusiasm for botany. He was one of the group of men who organized the Ecological Society and he served as secretary-treasurer of that organization from 1915 to 1919. He was its president in 1921. As editor of *Plant World* from 1911 until 1919, he did much to enhance the value of that journal. He was a member of the Association of American Geographers, serving as vice president in 1940, and of the Association of Pacific Coast Geographers, serving as president in 1942. He maintained membership in several other societies supporting work in botany and he contributed to their treasuries when financial difficulties overtook them. He collected plant specimens and kept a herbarium that grew slowly but constantly over a period of nearly half a century and donated his carefully annotated specimens to the herbarium of the University of Arizona when he retired. This herbarium was particularly rich in the ferns of Jamaica.

Papers dealing with plants, mostly ecological in emphasis, began to appear under his authorship in 1906 and continued to be published, up to a hundred in number, at fairly regular intervals until his retirement in 1941. In addition to *The Plant Life of Maryland* and his posthumous book on the floristics of the Sonoran Desert, he was author or co-author of four other books, including *The Distribution of Vegetation in the United States as related to Climatic Conditions.* Many of his papers were illustrated with halftones made from photographs of superb quality, taken with a heavy, cumbersome view camera using 8″ × 10″ glass plates.

When death overtook Forrest Shreve on July 19, 1950, only a part of his plan for recording the vegetational characteristics of desert areas in North America had been completed. Following his survey of the Sonoran Desert, he had done a good deal of work in Chihuahua, Mexico, and several papers from the pens of Shreve, C. A. Weatherby, I. M. Johnston, and

[1] The authors submitted separate accounts of Forrest Shreve, and the editors have combined them with the authors' permission.

probably from others, stand as a memorial to his vision and perseverance, for he worked under the growing burden of impaired health. In spite of this handicap he accomplished much and encouraged others to carry on the work he could not finish. He was a leader in the field of desert ecology, for his understanding of desert life and desert problems was founded on long experience, keen observation, and an analytical mind. He became almost a part of the desert he studied and knew so well.

Technical Papers

The Question of Extraneural Growth *in vivo* of Poliomyelitis Virus

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The cultivation of poliomyelitis virus in cell suspensions of various tissues (*1–3*) (skin, muscle, intestine, kidney, testis, etc.) has been interpreted as invalidating the assumption of obligate neurocytotropism of this virus in the intact animal, an assumption which Syverton and his associates explicitly state is "no longer tenable." There is a serious fallacy in inferring from *in vitro* growth of a virus in particular tissues that the same tissues are capable of supporting growth *in vivo*. It has yet to be shown in the living animal that cells of skin, muscle, kidney, or testis, in contrast to those of the nervous system, either support growth of poliomyelitis virus or display specific lesions, or, indeed, lesions of any kind, during the early stages of poliomyelitis. Certainly, dermatitis, enteritis, nephritis, and orchitis are not features of the clinical picture of the disease. Enders himself, in whose laboratory the first successful cultures of the virus were made on extraneural tissues, has made no such claim. On the contrary, he has stated (*1*), in discussing the factors influencing multiplication of viruses and rickettsiae in tissue cultures, that:

> The results of many studies with different viruses, however, have made it clear that the degree of pathogenicity exhibited by an agent for the intact animal is frequently not correlated with its capacity to increase in cultures prepared from the tissues of such an animal; . . . [and] Extracellular inhibitory mechanisms present in the living body may be eliminated in cultures, thus permitting multiplication.

There is some reason to believe that these remarks may well apply to the case of poliomyelitis virus. The method used, with various modifications, by Enders and others, in the cultivation of poliomyelitis virus, is that of Maitland and Maitland (*5*), using one of Hanks' salt mixtures and Simms' ox blood serum ultrafiltrate. Preliminary washing of the tissue appears to be important, both in the original preparation and in subcultures. The salt solutions depart widely from normal mammalian interstitial fluid in respect to electrolyte composition. The importance of electrolytes, at certain critical concentrations, in promoting the attachment of virus to host cell has recently been noted by Puck and his associates (*6*). The part played by ox blood serum ultrafiltrate in virus cultivation also appears to be critical. Simms (*7*), who introduced this material for tissue culture, found that normal tissue and serum contain several factors that affect cell growth and metabolism, one of which is inhibitory, one (A) stimulative, one (B) causative of fat granule production, one (C) degenerative, and one (D) causing cohesion of cells. The ultrafiltrate contains only A, removes B, C, and D from cells and counterbalances the inhibitory factor.

The presence of poliomyelitis virus in the intestine in the disease has been offered by Evans and Green (*8*), and more recently by Syverton and his associates, as evidence in support of extraneural growth of the virus, presumably on the cells of the oral and intestinal mucous membranes. The usual lack of signs of inflammation in these membranes early in the disease is suggestive contrary evidence. An alternative explanation, based on the characteristic neurotropism and axonal conduction of the virus, has been demonstrated by us in recent experiments (*9*), which showed that the virus is excreted into pharynx and gut as early as 3 days after neural exposures in which primary exposure of the pharyngeal or intestinal surfaces was rigorously excluded. At this time virus was demonstrable in the regional ganglia (*10*). In other experiments heavy exposures of the gastrointestinal tract, in which the oropharyngeal surfaces did not participate, were not followed, after the immediate postexposure period, by continuing excretion of virus such as might have been expected if the mucosal epithelium had become infected. In a single instance, excretion of virus began later, at the time when paralytic symptoms appeared, an indication of a neural source. In recent experiments, as yet unpublished, we found that nontraumatic oropharyngeal application of the virus was followed by the appearance at 2 days of specific lesions and at 3 days of recoverable virus from regional peripheral ganglia, whereas no evidence of infection of the CNS had appeared then nor for several days later. The experiments indicate an almost immediate entry and centripetal passage of virus through the superficial nerve fibers to the ganglia, without any lag such as

might be anticipated if primary implantation in the epithelial cells were the first step of the infective process. The findings are also inexplicable on the basis of early viremia.

Proof of the negative is always difficult, but it is a good general rule to give preference to explanations for which there is sound positive proof. In the case of poliomyelitis, neurocytotropism and axonal conduction of the virus *in vivo*, which have been proved beyond reasonable question (*11, 12*), provide an adequate explanation of the essential characteristics of the disease, whereas the theory of extraneural affinities, although revived periodically for several decades, remains without factual proof and only serves to becloud the pathogenesis of the disease.

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Fissidens pauperculus Howe and *Orthodontium gracile* Bruch & Schimper: Mosses Associated with the Coast Redwood Forest

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The geographical distribution of mosses appears to correspond closely with that of conifers in California. This hypothesis was first formulated by the writer (*1*) as a result of comparing the known distributional patterns of mosses with the units of various systems of classifying vegetational units pertaining to California. At that time a distribution pattern among mosses identical with the coast redwood forest was unknown, although known stations for *Fissidens pauperculus* and *Orthodontium gracile* were recognized as restricted to redwood areas (*2–4*).

With these facts in mind, the writer initiated a study of the bryophytes of the coast redwood forest, supported by a postdoctoral fellowship for the academic year 1950–51 from the Horace H. Rackham School of Graduate Studies at the University of Michigan.

The known range of the coast redwood is from Curry County, Ore., southward in the coastal counties of California to Monterey County, covering an area roughly 450 miles long and averaging 25 miles wide (*5*).

F. pauperculus was originally discovered in Marin County near Mill Valley in 1893 (*6*) and was not rediscovered until 1947 (*3*), when it was found near Larkspur and on Mount Tamalpais in Marin County, and also in the Big Basin Redwood State Park in Santa Cruz County (*4*). It has been listed as one of 16 mosses endemic to California and Baja California (*7*).

O. gracile was also first found in California by Howe, who found it on a redwood stump near Eureka, Humboldt County, in 1896 (*8*). In the same year Howe also found it in Mendocino and Sonoma Counties (*2*). In 1906, H. B. Humphrey collected it on King Mountain in San Mateo County. The writer found the moss in the Big Basin Redwood State Park in Santa Cruz County in 1947 (*4*). *O. gracile* has an interesting history in Europe (*9*), where isolated stations in Great Britain and France are known.

In September 1950, the author[2] visited the Chetco River Redwood Park in Curry County, Ore., and discovered both *F. pauperculus* and *O. gracile* there. This northernmost remnant of redwood forest is in grave danger of losing its vegetational character because of indiscriminate lumbering in the immediate vicinity.

The coast redwood forest has its farthest inland station on Howell Mountain in Napa County, where it grows in stream canyons. *F. pauperculus* was found there in Wildcat Canyon on the property of W. L. Wright, but *O. gracile* was not seen. If the latter species no longer grows on Howell Mountain, the thorough disturbance of the area by owners and Boy Scouts is no doubt a contributing factor.

Recently the Big Sur Redwood State Park in Monterey County was visited, and collections of both mosses were made in the park. Both species have been found to be abundant in the Armstrong Redwood State Park and in Russian Gulch in Sonoma County. Undoubtedly they will also be found in the remaining unexplored areas in which the coast redwood predominates.

The remarkable parallel distribution of *F. pauperculus* and *O. gracile* with the coast redwood appears too exact to have been the result of chance. Both ecological and historical factors are probably involved. The writer has previously (*1*) postulated a closer correspondence between the distribution of bryophytes and conifers than between either of these groups of plants and flowering plants. It was suggested that the common antiquity of bryophytes and conifers, when compared to flowering plants, may

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[2] Funds for traveling expenses from the Botanical Gardens of the University of Michigan are gratefully acknowledged.

be a contributing factor. According to the literature reviewed by the writer, there appear to be several additional instances of marked similarity between the distribution of certain mosses and conifers, but these have not been verified in the field.

Voucher specimens for the new stations of both species in the coast redwood forest will be deposited in the Herbarium of the University of Michigan.

The parallel geographical distribution in California and Oregon for the coast redwood and two mosses *F. pauperculus* and *O. gracile* is considered to be evidence for the previously formulated hypothesis that there is a close correspondence between the distribution of many mosses and conifers. The occurrence of *O. gracile* in isolated stations in Europe may be explained on the basis that mosses, because of their small size, may survive in microhabitats in areas where larger plants of similar ecological amplitude or tolerance (*10*) are unable to exist. The principle of microhabitats (*11*) promises to be of far-reaching significance in the study of the distribution of the smaller terrestrial organisms.

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Skeletal Muscle Changes in Scurvy with a Note on the Mechanism of the Attachment of Myofibrils to Tendon[1,2]

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It has long been known that degeneration of striated muscle is common in scurvy. Hyaline degeneration and fragmentation of the fibers, with great proliferation of nuclei are usually described. Dalldorf (*1*) noted that these changes varied with the degree of muscular activity and regarded them as part of the scorbutic syndrome, but Aschoff and Koch (*2*), Goettsch and Pappenheimer (*3*), and Wolbach (*4*) did not consider them to be specific to this disease. Others (*5–7*) have also described these changes in scurvy. Murray and Kodicek (*8*) studied guinea pigs who were receiving suboptimal doses of ascorbic acid, and whose fibulas had been fractured. The fibers of the adjacent muscles degenerated, and the sarcoplasm and myofibrils were removed by invading wandering cells. This phenomenon was interpreted as due to an increased degree of susceptibility to injury of the muscle of animals on diets deficient in ascorbic acid.

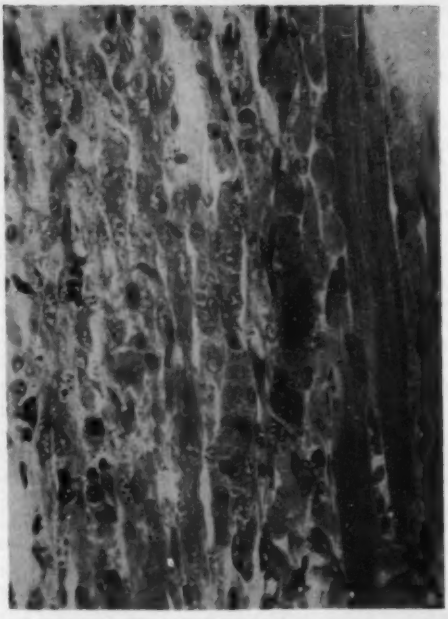

FIG. 1. Longitudinal section of thyroarytenoid muscle of guinea pig #25, which was on the scorbutigenic diet plus 0.5 mg ascorbic acid daily for 77 days. This and other sections were stained with hematoxylin and eosin. This section shows normal fibers and those in the early and late stages of hyaline degeneration, with much nuclear proliferation. × 400.

In the course of an investigation of the bones and teeth of scorbutic guinea pigs, the present writers noted that the hyaline and proliferative changes described by the above-mentioned workers occurred frequently in the muscles around the knee joint, ribs, scapulas, and trachea of animals receiving suboptimal doses of ascorbic acid for long periods (Fig. 1).

In acute scurvy, hyaline degeneration of these muscles was much less common. The finer structure of the muscle fibers became prominent, showing clearly the myofibrils and cross striations. The sarcoplasm seemed to be reduced in amount. Finally the fibers pulled apart. Nuclear proliferation occurred but to a less degree than in chronic scurvy (Fig. 2).

The changes in the muscles around the temporomandibular joints differed in both chronic and acute scurvy from those described above. Hyaline changes were only occasionally observed in chronic scurvy. In acute scurvy, areas were found where the muscle fibrils and sarcoplasm were seen to end suddenly, leaving intact and empty sarcolemma sheaths between

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[2] Aided by a grant from the Nutrition Foundation, Inc.

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which the endomysium fibers could often be distinguished (Fig. 3). A similar phenomenon is said to occur when muscle is put into hot water (*9*). Proliferation of nuclei, so conspicuous in other muscles, was absent. This change occurred at the insertion into the periosteum and also in the body of the muscle. In some cases the sarcoplasm and fibrils had a torn and serrated edge; in others, they suddenly faded away. The transverse striations of these torn fibers were not lost, as occurs in hyaline degeneration, nor were the fibers swollen. The longitudinal myofibrils became conspicuous. In some cases individual fibers stood out because of their eosinophilic staining, which was possibly due to an early degenerative change. Other muscle insertions, together with periosteum, might have torn off the bone, accompanied by hemorrhage, as is usual in scurvy, but this was a different phenomenon from that described above.

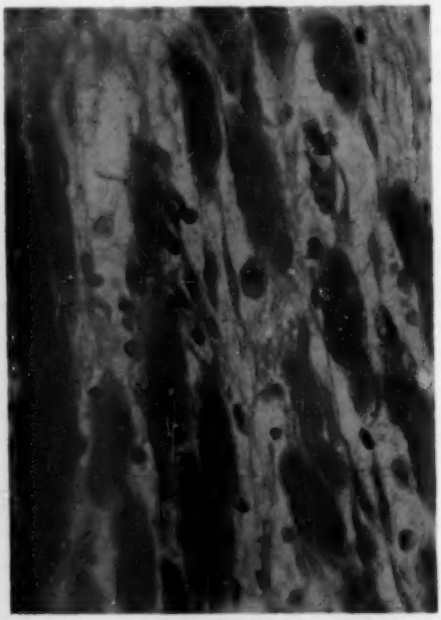

FIG. 2. Longitudinal section of intercostal muscle of guinea pig #100, which was on the scorbutigenic diet for 23 days. Fibers have broken up into short lengths, and their longitudinal and transverse striations are prominent. Moderate degree of nuclear proliferation, not so marked as in Fig. 1. A mitotic figure is seen in the middle of the field. × 400.

The attachment of muscle fibers to tendon or periosteum has long been a subject of controversy. Carr (*10*), among recent workers, upheld the view that the myofibrils continued into the tendon fibrils, the fate of the sarcolemma being uncertain. Goss (*11*) found that in both tendinous and periosteal junctions the muscle fibers ended completely and were attached by an argyrophil network, there being no continuation of myofibrils or of sarcolemma. Schultze (*12*), many years ago, proposed a compromise view that the

FIG. 3. Longitudinal section of the insertion of the external pterygoid muscle of guinea pig #99, which was on the scorbutigenic diet for 24 days. The mandibular periosteum is at the bottom. The sarcoplasm and fibrils have retracted in their sarcolemma sheaths, which are left intact and between which endomysium can be seen in some areas. × 400.

sarcolemma was pierced at its end by the myofibrils continuing into the tendon.

The present findings support the views of Goss, since the myofibrils pulled back, leaving an unaltered sarcolemma sheath. Had the myofibrils and sarcolemma been attached together at the periosteum, they would presumably have collapsed together. Ascorbic acid appears to be essential for the maintenance of the attachment of myofibrils to the sarcolemma.

The present writers feel that material such as theirs, obtained from a study of a deficiency state, could be used to advantage in investigations of normal structure, since the changes that occur are often a type of natural micromanipulation.

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Studies on Ketosis in Dairy Cattle, XV: Response to Treatment with Cortisone and ACTH[1, 2]

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In 1947 Shaw (*1*) reported that an extract of the adrenal cortex was very effective for the treatment of ketosis in dairy cows. On the basis of this work, histopathologic and biochemical studies extending over a period of 4 years (*2–5*), and the effective use of cortisone in the treatment of ketosis, it was postulated (*4, 5*) that ketosis in dairy cows is due to an adrenal insufficiency involving the adrenal cortex and the anterior lobe of the pituitary gland. The gross and microscopic changes observed in the various organs showed a striking similarity to those seen in experimental animals exposed to a noxious agent, causing the alarm reaction phase of the so-called general adaptation syndrome (*6*). These include regressive changes of the anterior lobe of the pituitary gland, enlargement and degeneration of areas of the adrenal cortex, involution of the thymolymphatic system, acute involution of the pancreas, gastrointestinal inflammation and ulcers, nephrosis, and fatty changes in the liver. Seven out of 8 cows treated with cortisone recovered from ketosis. Later it was found that the cow which did not respond did not have "spontaneous" ketosis (*5*).

TABLE 1

EFFECT OF CORTISONE AND ACTH ON BLOOD GLUCOSE AND ACETONE BODIES OF COWS WITH KETOSIS*

Cow No.	Treatment with cortisone acetate (C) or ACTH	Blood glucose (G) and acetone bodies (AB) in mg/100 ml						Remarks
		Before treatment		Days after treatment				
				1	2	3	4–7	
1	0.9 g (C)	(G)	30.2	38.3	47.5			Complete recovery
		(AB)	23.1	13.6	7.5			
2	0.9 g (C)	(G)	20.3	23.8	45.5	32.9	31.5	Recovered slowly
		(AB)		33.2	14.1	17.0	10.0	
3	0.9 g (C) + 0.3 g next day	(G)	15.6	30.1	37.2	38.3	41.3	Complete recovery
		(AB)	54.8		58.4	39.6	13.1	
4	1.5 g (C) + 1.0 g on each of next 2 days	(G)	17.3	44.8	59.7	44.0	49.4	" "
		(AB)	59.5	46.6	30.3	24.5	5.1	
5	1.5 g (C) + 1.0 g next day	(G)	23.5	59.4	60.8	50.7		" "
		(AB)	56.0	43.0	32.2	6.5		
6	1.5 g (C)	(G)	34.3	44.3		51.0		" "
		(AB)	40.1	26.6		8.8		
7	1.5 g (C) + 1.0 g next day	(G)	30.8	59.1	51.6	38.3		" " †
		(AB)	37.8	29.2	25.9	20.1		
8	1.5 g (C)	(G)	18.1	41.0		41.9		" "
		(AB)	38.5	23.6		5.6		
9	1.5 g (C) + 1.0 g next day	(G)	15.4	68.0	56.1	—	52.4	" "
		(AB)	59.4	51.9	39.3	—	6.9	
10	1.5 g (C) + 1.0 g 7 hr later	(G)	23.8	89.6	69.8	55.4	50.8	" "
		(AB)	63.0	30.3	25.5	8.4		
11	1.5 g (C)	(G)	17.6	51.3	44.0	33.2	33.2	" "
		(AB)	13.5	11.2	3.5	5.6	4.2	
12	1.5 g (C)	(G)	35.1	40.5	45.6	48.3	40.0	" "
		(AB)	18.9	13.6	13.5	10.5	4.6	
13	1.5 g (C)	(G)	20.3	53.2	43.5	42.4	45.4	" "
		(AB)			26.8	4.4	3.9	
14	1.5 g (C)	(G)	32.1	43.7	44.8	45.9	45.0	" "
		(AB)	47.2	47.9	41.6	35.7	6.5	
15	1.0 g ACTH	(G)	27.3	61.3	32.7	43.9	34.3	Initial recovery‡
		(AB)	27.9	32.2	23.8	20.6	22.3	followed by relapse
16	1.0 g ACTH + 1.0 g (C) 3 days later	(G)	15.4	86.7	42.7	44.0	47.0	Complete recovery
		(AB)	38.4	32.4	23.8	29.7	9.9	

* All cows recovered appetite within 24 hr after treatment.

† Urine Rothera test negative on 5th day.

‡ Recovered following additional treatments with ACTH and cortisone.

[1] Paper No. A 331, Contribution No. 2296, of the Maryland Agricultural Experiment Station.

[2] Supported in part by grants from the Association of Maryland Distillers and Allied Industries and Ralph E. Ogden Foundation, Inc.

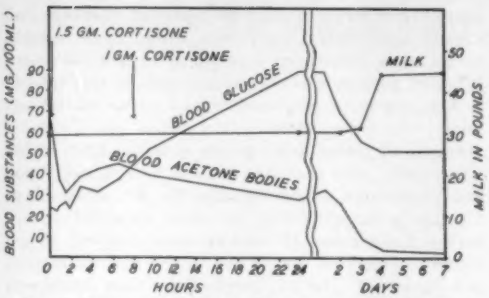

FIG. 1. Response of a cow with "spontaneous" ketosis to cortisone.

In the diagnosis of "spontaneous" ketosis the following criteria were used: hypoglycemia, ketonemia, refusal of feed, rapid loss in body weight, decreased milk production, incoordination, and either marked lethargy or high excitability. In addition, total leucocyte counts were made, and the rectal temperature was taken as an aid in detecting infections such as metritis. This report deals only with uncomplicated cases of ketosis. Blood glucose and acetone bodies were determined before treatment and at varying intervals after treatment. The methods used were the same as given previously (7).

The data on 14 cows with ketosis treated with a saline suspension of cortisone acetate (Cortone—Merck) and 2 cows treated with ACTH are given in Table 1. Both preparations were injected intramuscularly. In most cases there was a marked improvement in appetite within 18–20 hr. Within 48 hr the appetite was usually quite normal. Signs of incoordination and paresis always disappeared within 24 hr. The blood glucose usually increased to a level considerably above normal within 24 hr and frequently was above normal for 2 or 3 days. The blood acetone bodies returned to normal more slowly. The usual pattern was for the acetone bodies to continue at a high level for 2 or 3 days followed by a sharp drop to normal on the fourth or fifth day. The intramuscular injection of 1.5 g of cortisone was sufficient to produce complete recovery in the 6 cases so treated and recorded in Table 1. The administration of an additional gram a few hours later to Cow 10 and one day later to Cows 5, 7, and 9 appeared to be the most effective treatment. Cow 4 received 1 g/day for 2 additional days because the response was not marked until the second day after treatment.

In one case the blood glucose and acetone bodies were determined at frequent intervals following the injection of 1.5 g of cortisone with an additional gram being injected 7 hr later. It will be noted from Fig. 1 that the blood glucose increased markedly within 3 hr and was almost normal within 7 hr, when an additional gram was injected. On the following day the blood glucose was almost twice normal as a result of the rather large total dosage (2½ g) given during the first day. The blood acetone bodies did not return to normal until the fourth day after the initial treatment. Milk production likewise did not change appreciably until the fourth day, when a marked increase was noted. To date 25 cases of uncomplicated "spontaneous" ketosis have been treated with cortisone, and all have recovered completely, although it was necessary to administer cortisone as many as three to four times where relapses occurred.

Two cases were treated with 1 g of corticotropin (ACTH). Recovery of appetite, increase in milk production, and increase in blood glucose was similar to that obtained with cortisone. Additional treatment was required in each case before recovery was complete. Both cows had histories of previous attacks and had responded to dextrose treatment very slowly, so it cannot be concluded on the basis of these results that cortisone is any more effective than ACTH.

Some observations of considerable interest were made on normal and fasted lactating cows. Cortisone acetate was administered intramuscularly to 3 normal cows on an adequate energy intake and to 2 cows receiving 30% of the calculated net energy requirements for 5 days prior to and 1 day following injection (Table 2). Cortisone had little effect on the blood

TABLE 2

EFFECT OF CORTISONE ON THE BLOOD GLUCOSE LEVEL OF COWS NOT EXHIBITING "SPONTANEOUS" KETOSIS

Cow	Cortisone acetate injected	Blood glucose in mg/100 ml											
		Days before injection				Day of injection	Days after injection						
		4	3	2	1	0	1	2	3	4	5	6	7
Full-fed cows													
A	1.5 g					52.7	60.8	58.3					
B	1.0 g + 1.0 g next day			52.4	53.2	40.8	38.9	51.5					
C	3.0 g			50.0	55.8	45.1	55.9	55.4					
*Cows fasted before injection**													
D	1.5 g	59.1	55.6	34.6		36.5	93.4	78.8	69.7	60.2	57.5	52.1	58.6
E	1.5 g	44.0	36.2	27.0	31.3	27.3	79.1	64.8	62.1	54.8	52.1	52.1	53.2

* Beginning 3 weeks postpartum received 30% of net energy requirements for 5 days before and for 1 day after injection of cortisone acetate.

glucose of the normal cows even when as much as 3 g was administered in one dose. However, the injection of 1.5 g of cortisone into each of the 2 fasted cows resulted in a marked increase in blood glucose. This increase in the glucose was greater and was maintained at a higher level for a longer period of time than that observed in most cows with "spontaneous" ketosis that received the same amount of cortisone. A fasting ketosis was evident in these 2 cases, but the cows appeared to be quite normal otherwise. This was to be expected, since much more severe fasting has resulted in a marked hypoglycemia and ketonemia but has failed to produce the signs and symptoms typical of "spontaneous" ketosis (*8*).

It might be postulated that cortisone cures ketosis in cows purely because of the marked hyperglycemic effect of cortisone on fasted cows. The gross and histopathologic changes observed in cows with ketosis indicate a pituitary and adrenal involvement, however. Also, when smaller doses of cortisone have been used, the physical appearance of the cow has shown definite improvement before blood glucose increased. For example, Cow 2 in Table 1 exhibited a complete recovery of appetite and disapperance of incoordination within 20 hr after treatment with 900 mg of cortisone, even though blood glucose did not increase appreciably until the following day.

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Parthenogenetic Reproduction in *Phytomyza plantaginis* R.-D., the Second Reported Case in the Family Agromyzidae (Diptera)

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Hering (*1*) reported reproduction without males in *Phytomyza crassiseta* Zett., having caged unfertilized females with their host plant, *Veronica* sp. From these he obtained more females. He pointed out that it is exceptional to find a male in north Germany, whereas in south Europe the natural population consists of about 50% males.

Hering found it difficult to explain why parthenogenesis had not been found in the closely related *P. plantaginis* in Europe. Frost (*2*) mentions both sexes in describing the species from eastern North America. However, when the writer found that 125 adults reared from larvae mining the leaves of *Plantago lanceolata* L. in central California proved to be females, he set up a laboratory experiment to test the possibility of parthenogenetic reproduction in this species.

A specimen of plantain, free of larvae of the leaf miner, was transplanted into a gallon jar. Forty-six females, all reared from pupae obtained from Santa Cruz, Calif., and examined for sex, immediately upon emergence were introduced into the jar. After about 10 days a large number of mines appeared on the leaves. From these, 13 females were obtained, in addition to numerous larvae and pupae that were killed and preserved. The 13 females were then introduced into another jar containing plantain, from which 8 larvae were obtained. The experiment had to be terminated at this point.

A preliminary study of the reproductive system of those females producing viable eggs has shown the spermotheca to be present, indicating the possibility of fertilization in the presence of males. A study of the morphological basis for this phenomenon will be reported in another paper.

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Observations on the Apparent Failure of Beer's Law Near the Transmission Limit of a Solvent

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A recent paper by Ungnade, Kerr, and Youse (*1*) reports variations in the extinction coefficient of phenol with change in solute concentration, which the authors ascribe to a failure of Beer's law. They obtained log ε values of 3.00 to 3.68 (ε = 1,000 to 4,790) for the 218–219 mμ primary (*2*) band, and a shift in the maximum to 225 mμ at the highest concentration. Since deviations of this magnitude are not usual in spectrophotometric practice, observations were made on the compound to investigate the response of our own Beckman spectrophotometer under the given conditions.

Solutions of phenol in 95% ethanol were prepared over the concentration range employed by Ungnade, Kerr, and Youse, and the absorption curves were determined, using a constant slit width of 1.0 mm through the maximum of the primary band. Variations in the absorption of this band were generally like those observed by Ungnade, Kerr and Youse—namely, a substantial decrease in intensity and an apparent shift of the maximum to 222 mμ. However, the extinction coefficient of the secondary band maxi-

TABLE 1

ULTRAVIOLET ABSORPTION OF THE PRIMARY BAND OF PHENOL IN 95% ETHANOL (READINGS IN 0.020-CM CELLS)

Phenol conc (M/liter)	λmax (mμ)	log ε max
0.000702	218.0	3.782
.00143	"	3.779
.00230	"	3.770
.00366	"	3.769
.00428	218.5	3.772
.00545	"	3.772
.00757	"	3.760
.01085	"	3.752
.01354	"	3.757
0.0168	"	3.739

mum at 272.5 mμ was unchanged beyond that to be expected with modification in solution density (*3*) and was not perceptibly shifted in wavelength. A repeat study on a second series of solutions yielded comparable results.

In view of the discrepancy in the response of the primary band, a series of determinations was made on phenol using water as the solvent. It has better transmission characteristics than ethanol in the lower wavelength region, and observations can be made at sensitivity settings nearer the clockwise limit, in spite of a shift of the maximum of the phenol primary band to about 210 mμ in this solvent. Six consecutive readings over the concentration range 0.0000458M to 0.000210M gave ε values of 6,060 to 5,700 (log ε 3.783 to 3.756) for the primary band, with an apparent shift of the maximum of perhaps 0.5 mμ. Readings at the 270 mμ secondary maximum over the concentration range 0.0001042M to 0.001026M gave ε values of 1,570 to 1,460 (log ε 3.196 to 3.165), with no shift in wavelength. Comparison of these results with those obtained in ethanol would seem to indicate that adequate solvent transmission is a necessary requisite to accurate observation in the lower wavelength region.

Accordingly, solutions of phenol in 95% ethanol were prepared over the instrument density range and read in absorption cells of 0.020-cm light path. The small light path with these cells causes a substantial reduction in solvent absorption and permits readings with 95% ethanol to approximately 202 mμ at a slit width of 1.0 mm. Table 1 gives concentrations and data for the primary band. It is apparent that only small variations in extinction coefficient and wavelength result over a fairly wide range of solute concentration.

The differences in absorption obtained when solutions of phenol are read in cells of standard (1-cm) dimensions as compared with cells of small light path reflect the ratio of the intensity of the stray (not monochromatized) radiation to that of the monochromatized radiation. When solvent transmission is low, so that instrument capacities are strained, the stray radiation becomes a significant part of the total available to the phototube, and a drop in observed solution density results. For example, if $I_0 = I_m + I_s = 100\%$, where I_m is the monochromatized and I_s the stray radiation, when $I_m = 99\%$ and $I_s = 1\%$ for a solution transmitting actually 40% of I_m, the observed density will be $\log \frac{99+1}{0.4\times 99+1} = 0.391$. If I_s rises to 10%, the observed density for the same solution will be $\log \frac{90+10}{0.40\times 90+10} = 0.337$. These considerations are in accord with the conclusions of Saidel, Goldfarb, and Kalt (*4*) given in a recent discussion of false maxima and stray radiation in the lower wavelength region.

The experiments described above show that the wide range in extinction coefficient and wavelength shift observed by Ungnade, Kerr, and Youse for phenol in ethanol at different concentrations can be associated primarily with experimental difficulties in the region of reduced solvent transmission. Under suitable conditions, large variations indicating a failure of Beer's law do not appear.

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Progressive Tumor Resistance in Successive Generations of Inbred Immunized Rats[1]

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The influence of heredity on the incidence of cancer has long been the subject of investigation. Considerable evidence has been collected on the predisposition of humans to cancer, based on statistical studies, and the resistance and susceptibility to spontaneous and transplanted neoplasms, obtained from experimental studies in animals (*1–7*).

In earlier studies (*8–10*), it was found that rats of an inbred strain could be immunized against the growth of transplanted tumors by two methods of experimental procedure. The first method utilized subcutaneous injections of an alcoholic extract of tumor tissue for vaccination against tumor growth, after which the resistance of the treated rats was challenged by implantation of a small amount of viable tumor tissue. This method resulted in the development of tumor resistance in about 50% of the treated rats. Inbreeding of vaccinated rats resulted in an increase in response to this method of tumor

[1] Aided by a grant from National Cancer Institute, National Institutes of Health, USPHS, Bethesda, Md.

[2] With the technical assistance of Arthur E. Bogden and Peter Demchur.

TABLE 1

TUMOR IMMUNITY IN SUCCESSIVE GENERATIONS OF IMMUNIZED RATS*

Generations	No. treated	No. immune	No. not immune	Percentage immune
Response of offspring of three lines of immunized parents				
SA9	14	14	0	100
SA10	68	67	1	99
SA11	9	9	0	100
(13 litters)	91	90	1	99
SB9	11	8	3	73
SB10	23	23	0	100
SB10	31	27	4	87
(9 litters)	65	58	7	90
SC4	18	16	2	89
SC5	19	19	0	100
(5 litters)	37	35	2	95
Totals 27 litters	193	183	10	95
Response of offspring of vaccinated parents				
31 litters	145	126	19	87
Response of offspring of untreated parents				
19 litters	94	47	47	50
3† "	13	6	7	46
22 litters	107	53	54	50

* Two hundred untreated stock inbred rats implanted with challenge grafts of tumor tissue as controls on the viability of the tumor tissue developed tumors; none were resistant.

† Offspring of untreated parents of generations corresponding to last 3 generations of immunized parents.

immunization from 50% of the offspring of non-vaccinated rats to 87% of the offspring of vaccinated parents, as shown in Table 1.

The second method consisted of implantation of tumor grafts into normal rats, and when the grafts had grown to a small size, the rats were subjected to intratumoral injections of tumor extract. This procedure brought about oncolysis accompanied by the development of tumor immunity in 78% of the treated animals (*9*).

The present study is concerned with the influence of continuous inbreeding of rats, immunized in each generation, upon the response of their offspring to immunization either by subcutaneous or by intratumoral injections of the "vaccine"—alcoholic extract of tumor tissue.

All rats used in this study were of the same strain, closely inbred for many generations under the same conditions. A methylcholanthrene-induced sarcoma #231 (*11*), which had originated in a rat of this strain and to which the rats of this strain had proved to be 100% susceptible, was used for transplantation. The details of the preparation of the vaccine and the methods employed to induce tumor immunity are given in earlier publications (*8, 10*). Two deviations, however, were instituted in the present study—namely, only rats that had proved to be immune were used for breeding, and only transplanted tumors were used in the preparation of the tumor extract (vaccine) for subcutaneous treatment.

Three lines of subcutaneously treated rats, SA, SB, and SC, described in earlier studies (*8*) were further inbred through 11, 10, and 5 generations, respectively. The offspring of the immunized parents in each generation were injected subcutaneously with vaccine and 3 weeks later were tested for resistance. Those that proved to be resistant were tested 1–2 months later for tumor immunity. The immune rats were used for breeding the next generation.

Three lines of rats, TA, TB, and TC, immunized by intratumoral injections, were also inbred through successive generations. The offspring of the immunized rats in each generation were implanted with sarcoma #231, the resulting tumors were treated, and the cured rats tested for tumor resistance, and later for immunity (*9, 10*).

Each time treated rats were implanted with tumor tissue, 4–6 untreated control rats were implanted with a portion of the same tumor tissue to test its viability.

Table 1 shows the results obtained by continuation of inbreeding of the 3 inbred lines, SA, SB, and SC, of rats immunized by subcutaneous injections of vaccine. The rats of line SA are now almost 100% responsive to immunization by injection of vaccine. Only 1 of the 91 rats of the 13 litters comprising 3 generations of inbreeding failed to respond to the vaccine.

The rats of line SB show considerable progress in favorable response. Although only 73% of the 11 rats treated in the ninth generation proved to be immune, 100% of the 23 rats comprising 4 of the litters of the tenth generation were immune, and 87% of the 31 rats comprising the other litters of this generation were also found to be immune.

Of the 37 rats comprising 5 litters covering two generations of further inbreeding of the immunized rats of the SC line, only 2 rats—and these 2 were in one of the litters of the fourth generation—failed to develop immunity in response to vaccination. Every one of the rats in the other 4 litters developed tumor immunity following subcutaneous injections of the vaccine.

In previous studies (*8*) it was found that the response to this method of immunization of the offspring of vaccinated parents (87%) was less than that of the offspring of immunized parents (95%). Inbreeding of the rats has apparently not lessened their susceptibility to the growth of the tumor used, for, as is shown in Table 1, only 46% of the offspring of untreated parents, corresponding to the last 3 generations of immunized parents, proved to be immune.

In the studies of the continuation of inbreeding of rats immunized by intratumoral injection of vaccine, 3 lines of intratumorally treated rats, TA, TB, and TC, were inbred through 12, 11, and 6 generations, respectively. The 3 later generations, comprising 47

litters, or a total of 254 rats, which were first implanted with tumor tissue and later treated intratumorally with vaccine, proved to be 100% immune—subsequent implantations of viable tumor tissue failed to grow in every one of the 254 T rats treated in this manner.

In the T rats of the later generations, the rate of growth of the tumor grafts implanted previous to treatment was slower than in the rats of the earlier generations. Furthermore, they responded more favorably to intratumoral injections, in that, whereas in the earlier generations to obtain successful results it was necessary to treat small tumors 4–6 days after implantation, in the later generations the intratumoral treatments could be initiated on the seventh day with successful results. At the same time, fewer injections were required to bring about oncolysis. In some instances, oncolysis took place after only three injections.

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Histochemical Demonstration of Esterases by Production of Indigo[1]

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Esterolytic enzymes found in animal tissues are capable of splitting a wide variety of carboxylic acid esters (*1*). Among the aliesterases, specificity of action is provided by the size of the fatty acid moiety rather than the hydroxylic residue (*2, 3*). However, there is considerable overlapping in the hydrolytic properties of the carboxylic esterases. A simple ester such as β-naphthyl acetate is hydrolyzed by serum esterase, pancreatic lipase (*3*), serum cholinesterase, and acetylcholinesterase of brain and erythrocytes (*4*). A method for demonstrating esterase histochemically in acetone-fixed tissues was developed using β-naphthyl acetate as a substrate. By coupling the naphthol with a diazonium salt, an azo dye was produced which was deposited at the sites of enzymatic action (*5*). The process of fixation in acetone and embedding in paraffin removed most of the lipoids and inactivated nearly all the cholinesterase, so that the method served well to demonstrate the nonspecific esterases. However, the lipoid-soluble azo dye diffused in the lipoids of fresh-frozen sections, particularly in nervous tissue which contained acetylcholinesterase (*4, 6*).

Because of the poor solubility of indigo blue in both aqueous media and lipoids, it seemed worth while to examine the properties of indoxyl acetate as a possible substrate for esterases. At the pH optimum for esterase activity, indoxyl is rapidly oxidized to indigo blue and precipitated from solution (Fig. 1). Indigo

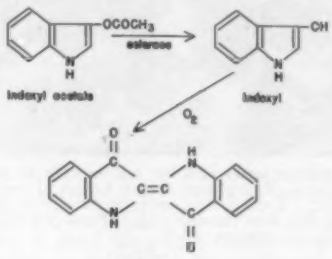

FIG. 1.

blue is a light-fast, stable, brilliant pigment. Indoxyl butyrate was also prepared and used in experiments to test the localization of acetylcholinesterase *vs* other esterases, particularly in nervous tissue.

Indoxyl acetate was prepared in the following manner: A 2-lb tin of sodium indoxyl in a mixed alkali flux, prepared as an intermediate in the industrial production of indigo, was obtained from a commercial source.[3] A portion of the flux was chipped from the solid mass and ground fine. The powder (64 g) was placed in a liter of water and ice in a 2-liter Erlenmeyer flask into which illuminating gas was constantly passed to prevent extensive oxidation. As soon as the melt dissolved, 40 ml 50% (by vol) sulfuric acid was rapidly added and stirred. This was followed by the addition of 25 ml acetic anhydride. The flask was stoppered and shaken. Illuminating gas was bubbled through the mixture vigorously for 10 min. A green-blue precipitate which had formed was collected with the aid of suction and washed with water. The filter cake was extracted six times by suspension in 300 ml boiling water, followed by rapid filtration by the suction pump. A little active charcoal was added during the last few extractions. The filtrates were combined, cooled, and 6–10 g of fine grayish needles was collected. The product was recrystallized from hot water or dilute alcohol in nearly white needles, mp, 126°–128°. The melting point has been reported (*7*) as being 126°–127°.

[1] This investigation was supported by an institutional grant to Harvard University from the American Cancer Society and by a research grant from the National Cancer Institute, National Institutes of Health, USPHS, FSA.

[2] Acknowledgment for technical assistance is due Ralph Gofstein, Robert M. Rubin, Lorraine Lamy, and Shirley Golden.

[3] Provided through the courtesy of J. D. Nantz, Pharmaceutical Laboratories, National Aniline Division, Allied Chemical & Dye Corporation, 40 Rector St., New York. It may now be purchased from this firm.

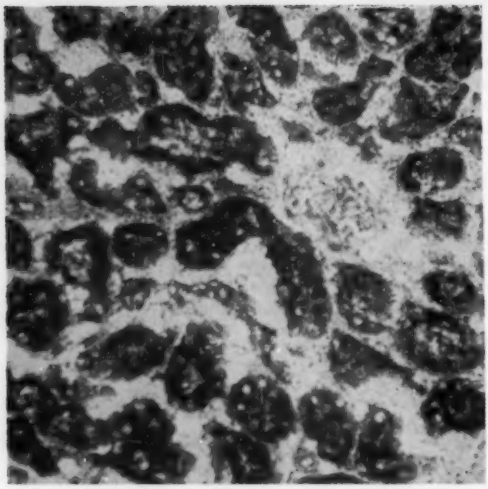

FIG. 2. Kidney cortex of a rat, 5 μ fresh, frozen-dried section. Marked esterolytic activity is indicated by granular deposit of indigo in the cytoplasm of the tubular epithelium. A glomerulus visible in the upper part of the photomicrograph shows sparse granulation. × 200.

The butyrate was prepared in a similar manner. Instead of acetic anhydride, 50 ml butyric anhydride (Eastman) was added. Crystals did not form readily because of the presence of the oily anhydride. The reaction mixture was allowed to stand at room temperature for several days until all the anhydride had decomposed and indigo-stained crystals had formed. The crystals were then collected and washed free of butyric acid. The product was crystallized by solution in methanol, treated with charcoal, and diluted, when heavy tan prisms separated, mp, 86°–87°. Infrared absorption spectroscopy revealed the presence of an ester linkage and no amide band.

Anal calcd for $C_{12}H_{12}NO_2$: C, 70.91 H, 6.45.
Found: C, 70.70 H, 6.60.

For the demonstration of esterases in tissues, fresh pieces of liver, pancreas, kidney, duodenum, fat, striated muscle, brain, and spinal cord were removed from rats killed by a blow on the head, and were frozen and stored at −30° C. Frozen sections, 5 μ thick, were prepared according to the Coons modification of the Linderstrøm-Lang technique (*8*) and dried. The slides carrying the mounted frozen-dried sections were incubated at room temperature in a fresh solution containing the following ingredients: 25 ml 2 *M* sodium chloride; 10 ml 0.1 *M* Michaelis barbital buffer, pH 8.5; 0.25 g calcium chloride in 14 ml distilled H_2O; 20 mg indoxyl acetate; and 1 ml acetone. The indoxyl acetate was dissolved in 1 ml acetone and mixed thoroughly with the 49-ml solution of salts and buffer just before use. This mixture was filtered into a Coplin jar containing the sections. After 10 min, the supernatant fluid was decanted, and the slides were washed in running tap water for 5 min. Cover slips were mounted with glycerogel. The procedure with indoxyl butyrate was the same except that the tissues were incubated for 15–20 min.

In the experiments in which esterase inhibitors were utilized, the tissue sections were incubated at room temperature with the inhibitor for 1 hr before the substrate was added.

Within 2 min the most reactive tissues, liver, kidney, and duodenum, hydrolyzed indoxyl acetate and were colored a perceptible blue. In 10 min, all the tissues studied were grossly colored, the central nervous system the least of all. The supernatant incubating medium remained clear and colorless during the 10-min period, indicating that spontaneous hydrolysis of the substrate did not occur in this time. In all the organs, the granular precipitate of indigo blue was limited to the cytoplasm; none occurred in the nuclei. No color developed in the sections if the tissues were first immersed in water at 98° C for 1 min.

The size and number of the granules varied from numerous small particles in liver and kidney (Fig. 2), few large particles in nervous tissue (Fig. 3), to a single large crystal which grew as a cluster from a single point in each fat cell (Fig. 4).

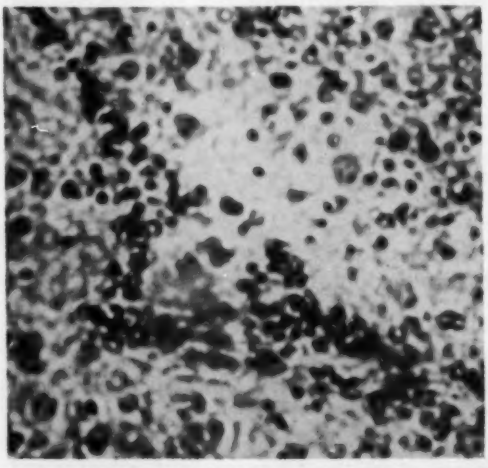

FIG. 3. Anterior horn cell from cervical region of a rat's spinal cord, 5 μ fresh, frozen-dried section. Granules of indigo are present in the perikaryon and in the cell processes. × 2250.

The cause of the granularity was not altogether clear. A slight delay in oxidation of indigo could have allowed sufficient diffusion to foci more favorable for oxidation and subsequent precipitation of indigo. A tendency to form a supersaturated colloidal solution of indigo at the sites of esterolytic activity in fresh tissue could have favored a certain degree of selective precipitation of the pigment on these or near-by foci. In tissues with few favorable foci, the granules would possibly grow to a larger size than in those with many foci. Therefore, within these limits, localization of enzymatic activity could not be assured.

The cytoplasm of liver cells stained intensely with a uniform punctate distribution of blue granules.

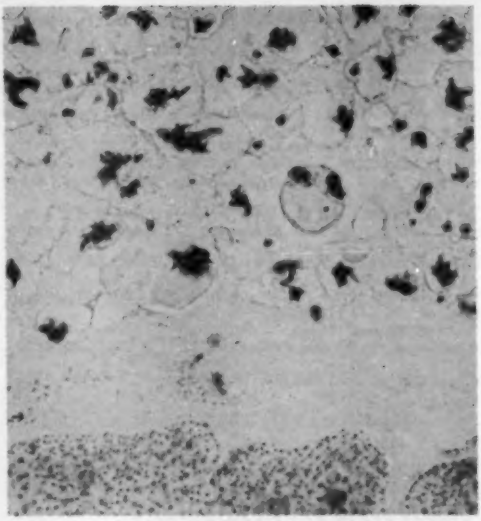

FIG. 4. Interscapular brown fat of a rat, 5 μ fresh, frozen-dried section. Note large crystalline deposits of indigo in each fat cell. Contrasting small granules at the base of the photomicrograph demonstrate the esterolytic activity in striated muscle. × 500.

There was no difference in concentration in either the portal or hepatic areas of the liver lobule.

In the pancreas, the acinar cells were darkly stained, as was the epithelium of the ducts. The islets of Langerhans were moderately positive.

All the elements of the nephron were positive. The cytoplasm of the epithelium of the proximal and distal convoluted tubules showed marked activity (Fig. 2), and the other tubular segments were moderately active. The glomeruli and all medullary elements were only weakly stained.

In the duodenum, the epithelium of the villi and the crypts of Lieberkühn reacted intensely, and Brunner's glands were moderately stained. The smooth muscle fibers and the neurones of the myenteric plexuses also displayed moderate activity.

Small punctate granules in the cytoplasm and at the surface of fibers characterized the staining of striated muscle.

The gray matter of the spinal cord and brain had a higher concentration of esterase than the white matter. In the anterior horns of the cord, the large stellate motor cells showed a moderate deposition of dark blue granules in the cytoplasm and in the axons and dendrites (Fig. 3). It was difficult to discern whether the indigo granules occurred on the cell surface as well as in the cytoplasm.

In the blood vessels in all organs studied, the smooth muscle layers were moderately positive, and the elastic tissue and endothelium were negative. Among the blood cells, intensely stained cytoplasmic granules occurred in the polymorphonuclear leucocytes.

Sodium taurocholate[4] (5×10^{-3} *M*) completely inhibited enzymatic activity in all tissues except pancreas. Enzymatic activity in this circumstance was considered to be due to lipase (*3*). Esterolytic action on β-naphthyl acetate was not as effectively inhibited by taurocholate. Eserine salicylate in concentration up to 8 μg/ml partially inhibited the degree of staining of central nervous system sections without any marked change in the distribution.

When indoxyl butyrate was used as substrate, the distribution of granular precipitate in all the tissues was similar to that of indoxyl acetate, except that the reaction was less intense despite a longer time of incubation. Spinal cord sections displayed weak esterolysis of the butyrate with and without eserine. However, the washed cell membranes of hemolyzed erythrocytes which were positively stained with the acetate were unstained with the butyrate. Since acetylcholinesterase of erythrocytes did not hydrolyze the butyrate, hydrolysis by nervous tissue was due to another esterase.

The carboxylic acid esterases are of three types: lipase, nonspecific or aliesterase, and cholinesterases. The first is an enzyme which has a predilection for esters of long chain fatty acids and is stimulated by sodium taurocholate. The second has a predilection for esters of short chain fatty acids and is inhibited by sodium taurocholate. The third has predilection for esters containing choline (*3*). Lipase occurs in large amounts only in the pancreas (*3*), whereas nonspecific esterase is widespread in its distribution in the tissues of the body (*9, 10*). Of the cholinesterases, serum cholinesterase is present in plasma, some organs, and in certain parts of the entire nervous system (*4, 11*); acetylcholinesterase is present in the central nervous system and membranes of erythrocytes (*11*). The latter enzymes may be distinguished from one another by their behavior toward acetyl β-methyl choline, benzoyl choline, butyryl choline (*11*), and carbonaphthoxy choline (*4*). Both enzymes are also able to hydrolyze certain acetic acid esters (*4*), β-naphthyl acetate, and indoxyl acetate.

The results of the present preliminary survey of esterase activity in fresh tissues of the rat indicate that indoxyl acetate is hydrolyzable by lipase, nonspecific esterase, and the cholinesterases. Lipase activity was demonstrable only in the pancreas in the presence of sodium taurocholate. Tissues known to be rich in nonspecific esterase were completely inhibited by taurocholate and not by eserine. A highly purified preparation of human serum cholinesterase[5] *in vitro* hydrolyzed both indoxyl acetate and butyrate. On the other hand, washed membranes of erythrocytes hydrolyzed only indoxyl acetate.

The staining of the central nervous system is presumably due in major part to acetylcholinesterase. The fact that eserine did not completely inhibit the reaction in sections of the brain and spinal cord, and that indoxyl butyrate was hydrolyzed to a slight extent by these sections, suggests that a small amount of

[4] Obtained from Elmer and Amend, New York.

[5] Provided through the courtesy of E. J. Cohn, University Laboratory for Physical Chemistry, Related to Medicine and Public Health, Harvard University.

another esterase is present in addition to acetylcholinesterase, in spite of a claim to the contrary (*6*). Since serum cholinesterase was not demonstrable in rat brain with the specific substrate, carbonaphthoxy choline (*4*), a small amount of the staining of the central nervous system with indoxyl acetate and butyrate must be attributed to the presence of a non-specific esterase.

Other methods for the histochemical demonstration of esterases have been described (*4, 5, 12–15*). A comparison of the distribution of enzymatic activity with these methods, with and without enzymatic inhibitors, will be reported elsewhere.

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Comments and Communications

Statement on Peyote

IN CONNECTION with the current national campaign against narcotics, there has been some propaganda to declare illegal the peyote used by many Indian tribes. We are professional anthropologists who have made extensive studies of Peyotism in various tribes. We have participated in the rites and partaken of the sacramental peyote. We therefore feel it our duty to protest against a campaign which only reveals the ignorance of the propagandists concerned.

Briefly put, the propagandists argue that Peyotists are simply addicted to a narcotic and intoxicant, which they use orgiastically.

Peyote is a small, carrot-shaped, spineless cactus which, in the U. S., grows in the Rio Grande Valley. The top of the plant is usually cut off and sun-dried, forming the peyote button. When taken internally, it appears to have remarkable mental and physical effects, although these have not been thoroughly studied.

According to Webster's *Dictionary*, a narcotic is a drug that "allays sensibility, relieves pain, and produces profound sleep;" an intoxicant "excites or stupefies." According to Merck's *Manual*, the symptoms of drug addiction are increased tolerance and dependence. On the basis of our experience, we would say that peyote seems to have none of these effects. It does not excite, stupefy, or produce muscular incoordination; there is no hangover; and the habitual user does not develop any increased tolerance or dependence. As for the immorality that is supposed to accompany its use, since no orgies are known among any Indian tribes of North America, the charge has as much validity as the ancient Roman accusation of a similar nature against the early Christians.

Actually Peyotism is a religion, with a national intertribal organization incorporated under the name of "The Native American Church of the United States." Its modern form, developed about 1870, is Christianity adapted to traditional Indian beliefs and practices. The basic tenets of the Native American Church are given in its articles of incorporation:

> The purpose for which this corporation is formed is to foster and promote religious believers in Almighty God and the customs of the several Tribes of Indians throughout the United States in the worship of a Heavenly Father and to promote morality, sobriety, industry, charity, and right living and cultivate a spirit of self-respect and brotherly love and union among the members of the several Tribes of Indians throughout the United States . . . with and through the sacramental use of peyote.

The belief is that God put some of his Holy Spirit into peyote, which he gave to the Indians. And by eating the sacramental peyote the Indian absorbs God's Spirit, in the same way that the white Christian absorbs that Spirit by means of the sacramental bread and wine. Peyote is used by Peyotists in two ways: spiritually and medically.

The traditional practice of many Indian tribes was to go off in isolation to contemplate and fast until a supernatural vision was achieved. This is now replaced by a collective all-night vigil in which, through prayer, contemplation, and eating peyote, the Peyotist receives a divine revelation. For the Peyotist, this occurs because he has put himself in a receptive spiritual mood and has absorbed enough of God's power from the peyote to make him able to reach God. A scientific interpretation might be that the chemicals in peyote diminish extraneous internal and external sensations, thus permitting the individual to concentrate his attention on his ideas of God and, at the same time, affecting vision and hearing so that these ideas are easily projected into visions.

The all-night rite is highly formalized. One man functions as priest, with the help of three assistants. During the rite they pray for the worshipers at fixed intervals, while the other men and women pray to themselves in low voices. Early in the rite everyone takes four pieces of peyote; later, anyone may take as many more as he or she thinks proper. Most of the time is occupied in having each man, in rotation, sing four religious songs that correspond to hymns sung in white churches.

Peyote is also considered as a catholicon, or cure-all. If a sick person is spiritually clean, the Holy Spirit in the peyote will help him get well.

We can state categorically that these two circumstances—spiritual and medical—are the only ones under which peyote is eaten by members of the Native American Church.

Finally, something should be said of the communion meal eaten toward the end of the all-night rite. It usually consists of water, corn, fruit, meat, and sometimes candy; these symbolize the major foods important to the Indians, and they pray to God to give them adequate amounts. According to the antipeyote propagandists, the fruit and candy are eaten to get over a "peyote hangover"!

It will be seen from this brief description that the Native American Church of the United States is a legitimate religious organization deserving of the same right to religious freedom as other churches; also, that peyote is used sacramentally in a manner corresponding to the bread and wine of white Christians.

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Pseudoscience and the DDT Scandal

JOHN PFEIFFER (SCIENCE, 114, 47 [1951]) should be entirely correct when he urges that scientists and science writers combat pseudoscience with terse, articulate communications to the public. But is he? Is the production of pseudoscientific articles traceable to writers without scientific experience in most instances? Let us examine Mr. Pfeiffer's proposal in the light of recent experiences. The DDT scandal, which has scarcely blown over, will serve as an example chosen from among many candidates.

A prize-winning science writer published the following statement in the Pittsburgh *Post-Gazette* during 1949: " . . . the mysterious ailment known as 'Virus X' disease, which has been breaking out in increasing numbers of American communities, affecting millions, is actually DDT poisoning." The article begins "DDT, the great bug-killer, may turn out to be one of the most devastating biological weapons ever loosed by a people upon themselves." In the next two short paragraphs one finds such fearful phrases as "boomerang," "wildly indiscriminate use," "grim menace to man himself," "frank alarm," "poisoning power," etc.

This is only a small sample of the fantastic language used by science writers and scientists alike, I am sorry to report. One scientist declared before a congressional committee, "I would not touch DDT with a ten-foot pole." Again, a science article in the New York *Post*, April 9, 1949, carried the nerve-quieting headline: DDT AND YOU! HOW IT MANACES THE NATION'S HEALTH. The first paragraph reads as follows: "Back in December, 1945, two research scientists, Dr. Horace S. Telford and James E. Guthrie of Ashland, Ohio, published a report in the highly respected periodical, *Science*, which indicated that DDT spraying of pastures or woodlands where dairy cattle graze, might poison users of their milk."

The above are merely a few samples of the superlative and absolute phrases used to describe the "menace of DDT" to mankind. Obviously, we are dealing here with a disaster inflicted on mankind by criminally careless and unduly optimistic scientists, or we are confronted with heedless defamation and malicious gossip that amounts to a first-rate scandal, created by scientists and science writers, who have received prizes from leading scientific associations for their efforts to popularize science.

The investigations by Telford and Guthrie, used to introduce one lengthy, vituperative article, were carried out in the Ohio laboratory which I direct. True, those scientists found that DDT or a toxic derivative may appear in milk of dosed animals, but they demonstrated that the dosages must be large and regularly used. From that work and from additional data that were collected promptly and published quickly (*Soap Sanit. Chemicals* [Dec. 1945]), Dr. Telford concluded that DDT was relatively nontoxic when used as an insecticide, and that it might be used safely for controlling flies on cattle. I concurred in that decision, and DDT was widely used without detriment to anyone's health, notwithstanding the headlines proclaiming that the menace threatened millions. Before congressional committees reputable scientists have patiently repeated the refrain—not one American has sickened or died as a result of the insecticidal usage of DDT. On the contrary, much sickness, economic loss, and annoyance which can be traced to insect activity have been averted by the use of DDT. Actually, therefore, the disaster, the threatening menace, were purely verbal. Both in theory and in actual use the insecticidal dosages of DDT were well below levels that are toxic to humans, and the DDT menace proves to be a bad dream.

By use of the "logical" techniques and literary styles of fanatics, scientists have caused the scientific method to be identified with the bombastic procedures

prevalent among other ideologies. If we employ absolute, nonscientific, emotion-packed phraseology, and startling but meaningless metaphors to present our findings to the public, naturally the nonscientist will harbor grave doubts regarding the alleged objectivity of scientists.

The fact is, Telford and Guthrie showed again that scientists can effectively evaluate the hazards inherent in the use of new products and can avoid most, if not all, of those hazards. Since no one was adversely affected by the widespread use of DDT as an insecticide, their conclusions seem valid. The contrary impression has been left in many a lay mind, because scientists have used the false and fantastic principles employed in so-called good writing of the present day.

In April 1949, I discussed the DDT scandal with a group of entomologists in Columbus, Ohio. I was urged to publish my findings and conclusions. I could state, for example, that Virus X and X disease were known before DDT was used. Therefore, the declaration that the insecticide was the sole cause of these conditions was based on a curious bit of retroactive and illogical reasoning. Although the article was much shorter than the scandalous bombast appearing in newspapers and magazines—although it was packed with facts instead of emotionalized fiction—publication was refused by several journals.

May I point out that this is a common experience of scientists producing honest, important, well-written, but nonsensational articles or statements. A brief quotation from a recent editorial (*Agr. Chemicals*, 6, 33) illustrates the statement:

> The viewpoint of the public, however, is somewhat jaded by newspaper stories which magnify the fears expressed by some witnesses that the country is being poisoned by use of these pesticides and that cancer, TB, polio, and heart disease are all products of these agricultural chemicals. Almost completely silent, however, are the newspapers, when sound (but unsensational) testimony is presented by witnesses of the caliber of Dr. Charles E. Palm, Dr. F. C. Bishopp, Dr. Frank Princi and Dr. George C. Decker, to name but a few of the many able and reliable scientists who have appeared.

Anyone who questions the ability of the above-named gentlemen to produce readable prose is referred to their several papers.

The articles that produced the DDT scandal and the *Saturday Evening Post's* editorial on the alleged suppression of Velikovsky's book do not differ in principle. Both took a minimum of reported facts, added a good dose of free fancy "to jazz it up," and described the result in bombastic terms. Both reject the honest relative phrase and employ the absolute sensational word. This is the essence of brief, modern "good writing," as opposed to an honest, scientific presentation. The effect upon the reader, whether the material is written by a scientist or by a *Post* editor, has frequently proved most unfortunate.

To generalize from such limited evidence may seem extremely hazardous, but space does not permit the marshalling of numerous other cases. To my way of thinking, the scientist or science writer who employs the sensational methods peculiar to so-called good writing in modern America will find ready acceptance of his productions by editors, but his literary activities will prove repugnant and embarrassing to his colleagues. The net result of his efforts will be a disservice to the advancement of science, for "good writing", or acceptable writing by modern standards, will rarely accommodate the important findings of science. I would like to explore further the reasons for this unfortunate situation, but this letter is already too long. I shall risk being classed as a defeatist by bringing it to a close.

Both this journal and the writer have in the past advocated a course of action similar or identical to that which John Pfeiffer advocated in SCIENCE. Unfortunately, experience clearly demonstrates that the recommended course of action leads to the same offense we deplore in lay writings, because it uses the same sensational techniques. Protestations that accuracy will avoid such pitfalls are useless, for the techniques employed in present-day "good writing" inevitably aggravate the tendency toward exaggeration among editors and scientists alike. Consequently, similar techniques lead to similar denouements, of which the DDT scandal and the *Post's* "Silly Season" are but two of many. The relative phrases of the laboratory, which are necessary to an honest, clear presentation of science, are not acceptable under modern standards, which demand the absolute or the sensational. The problem is more difficult than indicated by a simple shift from scientific terminology to popular phraseology. Its solution is desirable—even necessary and urgent—but not simple or easy.

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Numbness, Body-Image, and the Japanese Illusion

A VARIATION of the Japanese illusion not described by Schilder (*1*), who made frequent mention of this trick in his monograph on body-image, shows how one can "feel a sensation" in someone else's finger.

To perform the Japanese illusion in the usual way, the arms are pronated and the wrists crossed so that the palms are facing each other; then the fingers are interlocked, and the clasped hands are brought toward the body and rotated until a view of the fingers is obtained. When a person thus entwined is asked by pointing to move a certain finger, he frequently errs by moving the finger of the opposite side. Apparently an optic agnosia of right and left fingers temporarily exists until rectified by movement.

The variation lies in performance of the trick jointly by two individuals, using the right hand of one and the left of the other. When a person who is doing the trick for the first time is asked to stroke, with a finger on his free hand, one of his partner's fingers in the clasped hands, he will often say in surprise: "It feels like my finger, but it's asleep!"

What are the facts and implications of this simple experiment?

Foremost is the fact that the numbness is felt outside actual bodily limits. The subject "projects" a feeling of numbness to the locality of his partner's finger.

This use of *numbness*, meaning completely "dead" or "asleep," does not include partial sensation, such as tingling. It is like the numbness that is felt in an arm asleep over one's head when it must be lifted as a dead, heavy weight. It is like the feeling in one's lip experienced upon self-palpation after a dentist's injection of novocaine has completely numbed it. Whether this feeling is to be regarded as a negative tactile sensation, a positive tactile sensation, or a tactile sensation at all, poses an interesting semantic problem.

Three sources of stimulation may be recognized peripherally in the two-person Japanese illusion: cutaneous stimuli from the tip of the stroking finger, kinesthetic stimuli from the movement of stroking, and visual stimuli from observation of the act.

Conspicuously absent are cutaneous stimuli from the finger that is being stroked. But it has texture fairly like one's own finger, is in a position commonly occupied by it, and looks fairly like it. The brain's interpretation is then one previously learned for a similar pattern of sensory impulses: the part is asleep.

Certainly in the two-person illusion, and probably in other instances of this numbness, the feeling is entirely independent of cutaneous sensory impulses from the locality that feels numb. Visual stimuli (not to exclude visual imagery) are dispensable, since the illusion can be felt by the subject when his eyes are closed. But three subjects felt a numbness while watching the partner stroke his own finger! Apparently the numbness can also be felt upon the visual stimulation of watching the act and in the absence of the kinesthetic stimulation of the stroking movement. The implication is that criteria for this sort of numbness in a bodily part are: (1) palpation of the part (usually self-palpation), (2) absence of cutaneous sensory impulses from the part, and (3) self-identification of the part.

The third criterion, self-identification of the part touched, is interesting in the light of the concept of body-image. The central notion of body-image, developed and extended somewhat variously by Head (*2*), Schilder (*1*), and Lhermitte (*3*), is that every person holds in his nervous system a plastic model or idea of his own body, built up from past sensory experience (vision, touch, kinesthesis, etc.) and constantly modified by new experience. The body-image of a person gives the cues that permit him to locate accurately the parts of his own body, to judge properly the boundaries of his body in relation to other objects, and to have successful sensorimotor behavior in general. When a limb is amputated, the body-image is expressed in continued "projection" of sensation into a phantom limb; the body-image is said to be thus unmasked. Our experiment can also be said to unmask the body-image by demonstrating a potentiality of the nervous system for "projection" of numbness to a foreign bodily part under conditions sufficiently resembling those with which an own bodily part is identified.

An individual who immediately conceptualizes the experiment by properly identifying the fingers involved is not susceptible to the illusion. But when persistently asked if the stroked finger doesn't feel a little like his, he may presently report that he has captured the feeling. A suggestible person may almost turn the illusion on or off by persistently imagining that the stroked finger either is, or is not, his own. Similarly, concentrating attention on the stroked finger facilitates the illusion; on the stroking finger inhibits it. With repetition one may find that the illusion is increasingly difficult to produce. This suggests a learning of the new position or its incorporation into the body-image as other sensory data are brought to bear upon the problem.

A consideration of the phenomena of this and related experiments calls for greater structural definity of the still rather amorphous concept of body-image. Its review and elaboration bear on a physiological explanation of how somatic sensations are localized.

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The Mechanism of Visual Excitation

A significant advance toward the understanding of the mechanism of visual excitation has been made recently by Wald and Brown (*1*). They found that "the bleaching of rhodopsin by light exposes new sulfhydryl groups on opsin, two such —SH groups for each molecule of retinene liberated. The sulfhydryl group is highly reactive; it is weakly acidic, readily binds metal ions, and is a strong reducing agent." In particular, the sulfhydryl groups combine readily with silver ions.

The mechanism seems to become even clearer if we note that the *affinity of the sulfhydryl groups for such positive ions makes the totality of such groups an effective cathode*. But we already know that a nerve becomes excited under the cathode when the stimulus becomes sufficiently strong. One would therefore expect that the rod cells would become excited when a certain critical amount of rhodopsin has been bleached, thus producing a sufficient number of sulfhydryl groups.

The problem of how such effective cathodes cause

ions to move is one of considerable interest, but the excitation of nerve itself may perhaps be more profitably studied using real cathodes, since more is known about the way in which they function. However, it is conceivable that once one has the mechanism of excitation of nerve worked out, it may be possible to work backward and to piece together the intermediate processes occurring in the visual organ.

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Book Reviews

The American Illustrated Medical Dictionary, 22nd ed. W. A. Newman Dorland, Ed. Philadelphia-London: Saunders, 1951. 1736 pp. $10.00.

As science makes advances new terms are constantly being added. The job of keeping a medical dictionary up to date is difficult and complicated, and such a book requires numerous revisions and editions. Saunders medical dictionary, now in its twenty-second edition, has long served as an authority in its field, and this latest edition, published on its fiftieth anniversary, maintains its previously high standards of excellence. New terms are covered adequately, and old terms have been retained and elaborated upon in a satisfactory manner.

The volume is in a new typography and format, characterized by many illustrations to keep abreast of modern findings and changes in nomenclature.

Among new features in the book the editor has included a valuable preliminary article on the fundamentals of medical etymology and a table of modern drugs and dosages. He and the publishers are to be congratulated on this new edition; its excellence should assure continued publication for the next fifty years.

ALLEN E. HENKIN

Washington, D. C.

The Computation of Elements of Eclipsing Binary Systems. Zdeněk Kopal. Cambridge, Mass.: Harvard College Observatory, 1950. 181 pp. $5.00, $4.00 paper.

Eclipsing variables make it possible to study many properties of the stars which would otherwise be almost, or completely, closed to our investigation. Almost all our reliable information about their diameters and densities comes from this source, and under favorable circumstances it becomes possible to enter analytically the otherwise inaccessible interior, and find the internal concentration of density.

Modern photoelectric methods make observation of the light of an eclipsing system a simple matter—for the expert—with an accuracy approaching one part in a thousand. From such observations, covering the whole period, and showing fully the effects of the eclipse of each star by the other, a remarkable amount of knowledge may be derived.

Analytically, the theory that deduces the size and brightness of the stars, the orbital inclination, etc., is surprisingly complicated. Even the simplest case (two spherical stars and a circular orbit) can be solved only with the aid of extensive numerical tables of special functions. With their aid a precise solution is usually possible, but there remain cases in which a solution is indeterminate without additional information. In the more complex cases, when the stars are close together, distorted by tidal forces, and heated on the facing sides by each other's radiation, a fair approximation may be reached by a theory, first suggested nearly forty years ago, that assumes the components to be similar ellipsoids. Methods for improving this solution to any desired degree with the aid of very extensive expansions in series were later developed by Dr. Kopal. Still more complications, such as the presence of streams of gas escaping from the stars, or of bright patches on their surfaces, sometimes occur, but are not yet amenable to theory. Eclipsing systems, therefore, are as interesting to the mathematician as to the astrophysicist.

The present work supplements the author's earlier volume, *An Introduction to the Study of Eclipsing Variables,* published in 1946, and deals with methods for the numerical solution of the various forms presented by the problem. Though no numerical examples are given, the presentation of theory and practical procedure is complete and lucid. The specific treatment is highly technical (as it should be) and comment on its details may well be left to reviewers in professional journals.

It appears more to the point to note certain differences in the manner of discussing even such recondite matters when seen from different angles. These are primarily differences of taste and preference and all the more interesting because of the traditional impossibility of resolving the dispute.

Dr. Kopal's approach is that of a fairly pure mathematician who feels strongly the element of uncertainty and of personal idiosyncrasy involved in the use of a freehand curve drawn to represent the observations. He prefers to make even the first of the successive approximations required in the solution by a discussion of all the relevant observations by least-squares—even though it is clearly recognized that the first approximation must ordinarily start with such

inaccurate estimated values that its results will be considerably (though less) in error—and to use this first result as a basis for a second least-squares solution, and so on until this iterative process converges to the true value. Most other workers (including the reviewer) believe that it is more profitable to make these preliminary adjustments by graphical methods, and test them by plotting the light curves derived from them against the points representing the observations. Both agree that a definitive adjustment should be made by least-squares *after* the "perturbations" due to the deviations of the figure of the components from the ellipsoidal form (and many others) have been calculated and applied.

It should be emphasized that this question is not one of truth versus error; it involves one of Mark Twain's "differences of opinion that make horse races."

A detailed description of the methods of the other school is already partly published, and the observer and computer may then bet on either side.

HENRY NORRIS RUSSELL
Princeton University Observatory

A Source Book in Animal Biology. Thomas S. Hall, Ed. New York–London: McGraw-Hill, 1951. 716 pp. $10.00.

Biologists of every variety stand indebted to the editor, the publisher, and the American Philosophical Association for their respective parts in preparing and publishing this volume, the sixth in a notable series. The book has two primary purposes. The first is to increase the general availability of the classics in zoology. The second is to enable students to trace the development of thought and knowledge in the major fields of biological investigation. Both purposes are well carried out.

The 120-odd selections are organized under 8 main headings: "Cellular Biology," "The Origin and Development of the Individual," "Physiology," "Pathology," "The Basis of Animal Behavior," "Evolution and Heredity," "Zoögeography" (three selections only), and a catchall category, "The Organization of Animal Life." The value of the compilation is greatly augmented for students by the introductions provided for each selection. These are masterpieces of deft condensation, clear, informative, and to the point.

Obviously this is not a book to be read from cover to cover and returned to the library, but rather one to live with. It will provide a continuing source of profit, and enjoyment as well, for years to come. One is tempted to paraphrase a remark which the great English mathematician Cayley made about his field.

> It is difficult to give an idea of the vast extent of modern mathematics. The word "extent" is not the right one. . . . I mean a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail.

Beginning with da Vinci, Hall has assembled the pith and substance of the work of all the leading and many of the lesser biologists whose work lay primarily with animals, a truly immense undertaking. Here are key passages from Bonnet and Claude Bernard, Descartes and Darwin, Hooke and Huxley, Malthus and Metschnikoff, Vesalius, Verworn, and dozens of others. Some selections were especially translated.

The only real problem arises from the necessary limitations in size for a single volume, coupled with the immense wealth of biological literature. A companion volume seems the only answer for those who would like Ross as well as Manson and Smith, Dzierzon as well as Fabre, Owen and Gegenbaur as well as Oken and Haeckel, or de Maupertuis as well as La Mettrie. The editor must have been faced with many difficult choices. The present reviewer believes he has maintained a representative balance with only one or two exceptions. When mystics like Bergson and Driesch receive 8 pages each, it seems a pity to have excluded Jacques Loeb completely.

In an age when the value of firsthand knowledge of sources and even of laboratory experience is being challenged by the lovers of dogma, this volume is doubly welcome. Biological knowledge presented on a single flat plane without any historical depth tends to be brittle no matter how brilliantly illuminated. This book will make for wisdom.

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The Topology of Fibre Bundles. Norman Steenrod. Princeton, N. J.: Princeton Univ. Press, 1951. 224 pp. $5.00.

This book is an excellent technical exposition of the subject of fiber bundles—a subject which has been developed over the past 15 years with no previous attempt at a systematic organization. It is primarily of interest to the specialist in topology, although Part I presupposes only a modest knowledge of point set theory. Parts II and III require more extensive preparation of the reader.

The concept of a fiber bundle developed from the study of differential geometry, where it has its most important applications. It is a generalization of the notion of product space allowing twisting "in the large." In analogy to the graphs in the product space there are the cross sections in the fiber bundle. This has proved to be an adequate concept for the study of certain subjects, such as tensor fields on manifolds, for which the simpler concept of product space was quite inadequate.

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News and Notes

Seventh Conference on Iroquois Research

THE value of an informal gathering for reporting research accomplished, for stimulating new research, and for integrating methods of related disciplines, was again demonstrated Oct. 5–7, when students of the Iroquois met for the seventh year at Red House, New York, to discuss the theme of stability and change in Iroquois culture history. The annual Iroquois Conference, which owes its inspiration to the late F. G. Speck and looks to W. N. Fenton to arrange the program, comprises mainly anthropologists, but specifically ethnologists, archaeologists, linguists, historians, a psychiatric case worker, museum directors, lawyers, and a superintendent of Indian affairs—who are either professional or amateur students of some aspect of Iroquois culture. From the principal universities, museums, and research institutions in Canada and the Northeastern states, students of Iroquoiana come to Red House Lake for the week end, without consideration of status. They join no society, pay no dues, and they have happily resisted organization. The place of meeting has contributed enormously to the success of the meetings: Charles E. Congdon, chairman of the Allegany State Park Commission, issues the invitations, annually proclaims the weather, and welcomes the conference to the park. People come to see the wildlife and the autumn foliage and to enjoy the hospitality of M. H. Deardorff, of Warren, Pennsylvania.

In previous years sectional discussions of research areas, substantive reports of field work, summaries of abstruse topics such as linguistics, a rigorous symposium on a theme, meeting separately and in plenary session have been tried, but this year the conference returned to general sessions interlarded with section meetings, so that everyone could hear the main papers and yet share his problem with a more intimate group having similar interests. *Rapporteurs* summarized research trends in a final general session. The success of the conference depended on the high level of general papers, the plan of conducting the meetings, the quality of personnel in attendance, and tightening up the program.

The conference moved forward on a central theme, which Fenton set in a paper entitled "Stability and Change in Iroquois Culture History" on Friday night. Discussion sought possible indices of stability in linguistics, archaeology, ethnology, and history. Apparently historic contacts have produced rapid change, diversity, and early conservatism in different areas of Iroquoia, the eastern groups remaining most conservative in archaeology and language from early times. The western groups show early change and later conservatism. The theme carried over into the presentation, Saturday morning, of "Iroquois Kinship," by Harry Basehart (Goucher), which proved the display piece of the meeting, and was followed by spirited discussion led by F. Lounsbury (Yale). Basehart finds in changing kinship evidence of both historic contact and internal evolution.

While the ethnologists retired to explore possible methods for three related projects in personality and culture by A. F. C. Wallace (Pennsylvania), M. Randle (Brantford), and M. Teicher (Toronto), the archaeologists and historians heard Charles Wray (Rochester) describe the excavation of historic Seneca cemeteries. If it is true, as J. Witthoft (Pennsylvania Historical Commission) claims, that the Iroquois conferences have changed the face of archaeology in Pennsylvania, New York, and Ontario, we at least note with pleasure application of the direct historic approach to Huron and Iroquois townsites and the beginnings of sociological interpretations of settlement patterns, in which the findings of ethnology are employed to explain what the ground yields. The work of Ritchie (New York State Museum) and his associates in New York is being paralleled by the University of Toronto group for whom Norman Emerson spoke on "Historical Archaeology in Ontario," describing the splendid cooperative endeavor of the staff of the Royal Ontario Museum of Archaeology with amateur scholars, of whom Frank Ridley (Islington), discoverer of the Lalonde pottery complex, which may be ancestral to both Huron and Onondaga ware, was present to display a magnificent collection of pottery vessels. K. E. Kidd, codiscoverer with Ridley, of the Ossossané ossuary, described by Pere Brébeuf in the *Relations*, shared some observations on ossuaries in general; Kidd is currently studying trade goods as Guggenheim fellow from Canada.

The Saturday night Indian party, a tradition at the conference, witnessed the Red House premier of *The Longhouse People*, a documentary film in color, directed by Alan Worgon and produced by the National Film Board of Canada, with Iroquois actors from the Six Nations Reserve. The picture appeals to persons familiar with the culture who recognize the people of Six Nations Reserve as represented by Deskaheh (Chief Alex General, Cayuga), George Buck (who sang for the first Fenton album), and Howard Skye. The film features several conspicuous incidents in Iroquois ceremonialism, including War Dance for rain, the False-faces, and the Hymn to the Dead Chief and the Charge to the New Chief from the Condolence Council. Use of the French flute introduces a malapropism for the reedy note of the native flageolette, but the theme is in keeping with the picture, although its use in the mourning scene is puzzling. The best comment came from Senecas present, who, with characteristic local pride, avowed they could themselves make as good a movie at Allegany.

Using two Seneca informants, Joe E. Pierce, a student of C. F. Voegelin, demonstrated the Indiana method of recording and testing intelligibility of Indian languages, which involves two magnetic recorders, and offers possibilities for translating long ethno-

logical texts. The recorded document is dubbed onto the second machine, stopping at intervals to record parallel strips of English translation. The test can be repeated on several subjects in the same and in distant communities. Lounsbury, addressing the Senecas present in Oneida, showed how similar results can be achieved without the apparatus, if the linguist knows one other related language.

A substantial number of persons remained for the Sunday morning session to hear the *rapporteurs* summarize progress in ethnology and archaeology. Martha Randle pointed up the relation of several research projects in ethnology to the theme of the conference. A drift away from studies in ceremonialism and more conservative topics may be noted; Basehart's kinship study links Morgan with the present; and three current projects approach personality and culture. Investigating ambitions of children at Six Nations Reserve, Randle finds no significant differences in aims of children from Longhouse and more acculturated families. Wallace's projected study of the life and times of Handsome Lake, the prophet, may entail devising new Thematic Apperception Tests to employ situations arising in Longhouse life, possibly patterned after native Indian drawings. Teicher's study at Deseronto represents pioneer work in the most acculturated Iroquois community.

Besides the trends already noted in archaeology, Witthoft, seconded by the historians and archaeologists present, suggested featuring ethnohistory at the next conference, an area in which archaeologists want help. What are the critical means of deciding where a town mentioned in the records is located?

The chairman then turned to Lt. Col. E. P. Randle, requesting a private estimate of the crucial administrative problem in the affairs of the Six Nations, to the solution of which a team of anthropologists and others might make a significant contribution. Representative government, though nearly thirty years old at Six Nations Reserve, has failed to gain the support of more than a minority of the population, and the hereditary council of chiefs, which went underground in protest against the Indian Act of 1924, remains the governing body of the Longhouse people, seconded by a faction of Christians called the Mohawk Workers, who otherwise withdraw from active participation in the life of the community. The people of Six Nations unite on one issue only—the integrity of their "Nation" and the preservation of their lands. In common they fear enfranchisement. What is the real basis of factionalism? How is factionalism related to the process of acculturation? What can be done toward producing unity in such a situation? What lessons does the history of the last generation of Six Nations Reserve hold for the administration of native peoples and, more important, what lessons does it hold for predicting the outcome of contacts between the great powers and peoples of so-called underprivileged areas? Here is an example of what administrators may expect wherever native cultures are suppressed in the name of progress. Here is a laboratory for training students in the behavioral sciences.

The Iroquois Conference will continue on its present informal basis so long as present personnel desire to meet and share interests. It was decided, however, to go ahead with an *ad hoc* committee to explore ways and means of forming an Institute for Iroquois Research to get support for larger cooperative projects, to administer fellowships for the development of social scientists in the field of its interests, and to center its resources and activities in one of the institutions already identified with Iroquois research.

WILLIAM N. FENTON

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Scientists in the News

After 11 years with the Department of Geology at The Johns Hopkins University, **J. L. Anderson** has entered commercial work and is associated with Ralph E. Davies in Houston.

Maurice Bender has left the protein division of the Eastern Regional Research Laboratory to become pharmacologist for the Sanitary Chemistry Branch of the Medical Laboratories at the Army Chemical Center.

Recent additions to the field staff of the International Vital Statistics Cooperative Program of USPHS include **Joseph A. Cavanaugh,** formerly of Western Washington College, **Irvin R. Vaughn,** formerly Washington State vital statistics registrar, and **John W. Morse,** formerly in the Division of Venereal Disease, USPHS. They will be assigned to Latin-American countries. The statistics cooperative program, which is conducted by the National Office of Vital Statistics of USPHS, assists in the development and improvement of vital and health statistics in countries participating in the Point IV program of the Department of State.

Donald W. Collier has been appointed director of research for Thomas A. Edison, Inc., West Orange, N. J. Dr. Collier, who will have charge of the Edison Central Research Laboratories, has been with the Sharples Corporation of Philadelphia, where he was in charge of chemical research and process development.

John Thomas Godwin, of New Orleans, has been made head of the Division of Pathology and pathologist in the hospital at Brookhaven National Laboratory. He succeeds **Sidney C. Madden,** who recently accepted the professorship of pathology at the University of California at Los Angeles. In New Orleans he has been serving as pathologist for the Ochsner Clinic and Foundation Hospital and as lecturer in pathology, Tulane University School of Medicine.

James Norman Goodier, professor of applied mechanics at Stanford University, has been appointed

visiting lecturer at Harvard University for the first semester of the academic year 1951–52. **Arthur Kantrowitz,** professor of aeronautical engineering and of engineering physics at Cornell, has been appointed visiting lecturer in fluid mechanics for the second half of the year. Professor Goodier is lecturing on "Vibrations and Dynamics" and on "Elastic Stability." Professor Kantrowitz will lecture on "Shock Waves" and "Compressible Fluid Phenomena."

P. H. Hermans presented the McGregory Lecture in Chemistry at Colgate University. Dr. Hermans, director of the Institute for Cellulose Research of the Algemene Kunstzijde Unie N. V. (AKU), Utrecht, spoke on "Some Recent Topics of Cellulose Research."

Vincent Hernandez (MC, USN, ret.) has been appointed associate medical director for the overseas company of E. R. Squibb & Sons. Dr. Hernandez joins Squibb following more than 30 years' service in the medical department of the Navy. He will be concerned with clinical investigations of medical problems affecting those countries to which Squibb research can be of service.

Samuel P. Hicks is the first winner of the United Cerebral Palsy's Max Weinstein Research Award for the "outstanding scientific achievement" of the year in the field of cerebral palsy. Dr. Hicks is associated with Harvard Medical School and New England Deaconess Hospital in Boston, and with the Pondfield State Cancer Hospital in Walpole, Mass. The award, which consists of a plaque and $1,000 in cash, was established with a fund left by the late Max Weinstein, chairman of the board of Russeks–Fifth Avenue, New York, to spur research in cerebral palsy.

John Laurence Kask has been promoted to the position of chief of the Fish and Wildlife Service's Office of Foreign Activities. Dr. Kask, who has been assistant director of the service's Pacific Oceanic Fishery Investigations in Honolulu, will succeed **Hilary J. Deason,** who resigned in September because of poor health.

Henry A. Laughlin, president of the Houghton Mifflin Company, has been elected president of the Princeton University Press. He succeeds **Whitney Darrow,** vice president of Charles Scribner's Sons. Mr. Laughlin has been associated with the Riverside Press and Houghton Mifflin since 1914. The announcement was made at a dinner honoring Mr. Darrow, who, at 70, is retiring from the presidency because of the age limit set by the Press bylaws. Elected with Mr. Laughlin were **Hugh S. Taylor,** vice president; **Curtis W. McGraw,** treasurer; **Ricardo A. Mestres,** assistant treasurer; and **Datus C. Smith, Jr.,** secretary. The editorial board will consist of **Carroll C. Pratt, Jacob Viner,** and **G. E. Bentley.**

Joseph Augustin LePrince, sanitary engineer, has received the first Joseph Augustin LePrince Award, established by the National Malaria Society in his honor to recognize "outstanding accomplishment in malaria control." Mr. LePrince, 76, lives in Memphis, and is best known for his work with William Crawford Gorgas in freeing the Canal Zone of mosquitoes. The award will be given by the National Malaria Society or its successor when circumstances warrant. The cash award was made possible this year by the Michigan Chemical Company.

David E. Lilienthal has received the 1951 Public Welfare Medal awarded by the National Academy of Sciences for eminence in applying science to the public welfare. Mr. Lilienthal was honored for his leadership as former chairman of the Atomic Energy Commission and the Tennessee Valley Authority. The award is a medal inscribed with Archimedes' phrase "Give me where I may stand and I will move the world," and was established through the Marcellus Hartley Fund set up by Mrs. Helen Hartley Jenkins in honor of her father. The presentation was made at the academy's dinner at Yale University by Oliver Buckley, president of Bell Telephone Laboratories.

Pascal F. Lucchesi, chief of the Bureau of Hospitals and medical director of the Philadelphia General Hospital, has been named executive vice president and medical director of the Albert Einstein Medical Center, which is being organized through the consolidation and expansion of three hospitals. Dr. Lucchesi was selected by a committee of 30 civic leaders headed by Albert M. Greenfield, representing the boards and medical staffs of Jewish Hospital, Mount Sinai Hospital, and Northern Liberties Hospital. Dr. Lucchesi is completing the first phase of a $30,000,000 program at the Philadelphia General Hospital, where he was appointed superintendent in March 1946.

Martin Meyer retired as professor of chemistry at Brooklyn College on Nov. 1. He will continue his activities as a technical consultant and as director of the Chemical Branch, 1026 ORASU, First Army.

David C. Miller has been appointed assistant director of research in Philips Laboratories, Inc., and administrative assistant to the president. Since 1948, Dr. Miller has been a scientific warfare consultant for the Research and Development Board of the Department of Defense. He also taught an x-ray course in the graduate school at Georgetown University.

Joseph W. Mountin has been appointed chief of the Bureau of State Services, USPHS. Dr. Mountin succeeds **C. L. Williams,** whose retirement from the service ends nearly 40 years as a commissioned officer. He received his commission in 1912. Dr. Mountin entered the service five years later—in 1917. Both attained the rank of Assistant Surgeon General.

Roy C. Newton, vice president in charge of research in Swift & Company, has been named to receive the 1952 medal of the Industrial Research Institute, Inc. The medal has been awarded annually since 1945 for "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or

the public welfare." The Industrial Research Institute was organized in 1938 under the auspices of the National Research Council. It has a membership of 120 companies, with research staffs totaling more than 25,000 persons. Among its broad objectives are the promotion of improved management of, and high standards in, industrial research.

James St. Clair Polson, of the RAF, has joined the Air Force School of Aviation Medicine as a British exchange officer. Chosen in August for a year of overseas duty as a medical observer in this country, he succeeds Wing Commander **James S. Wilson,** as British liaison officer at the school. Wing Commander Polson is one of four medical officers from foreign air forces who are sitting in on the latest class of aviation medical examiners. After his graduation he will be assigned to the faculty of the school.

The annual dinner of the City College (New York) Chemistry Alumni Association this year will be tendered in honor of **William L. Prager** and **Reston Stevenson,** who will retire from the chemistry faculty at the end of the current academic year.

Otto H. Schade, radio and television engineer of the RCA Tube Department, has been named the first recipient of the David Sarnoff Gold Medal Award of the Society of Motion Picture and Television Engineers. The award was established this year by the Radio Corporation of America and named in honor of the RCA chairman of the board. Mr. Schade was honored for his recent development of a unique system of universal ratings and allied electronic testing equipment with which the quality of 35-mm motion-picture film can be measured in objective mathematical terms. The ratings, in turn, can be applied to determine the picture-reproduction quality of theatre television systems.

A. N. Steward, founder and former head of the Department of Botany at the University of Nanking and for many years curator of the herbarium at that institution, was recently appointed associate professor of botany and curator of the herbarium at Oregon State College. Dr. Steward returned last year to work at the Arnold Arboretum toward completion of his flora of the lower Yang-tse Valley. During the past summer, Dr. Steward continued his studies under a Guggenheim fellowship.

The following persons from abroad were recent visitors at the Eastern Regional Research Laboratory, Philadelphia: **A. K. Zweede,** The Netherlands Ministry of Agriculture; **R. Belcher,** Birmingham, Eng.; **E. M. Meade,** Manchester University, Cheshire, Eng.; **A. von Kreveld,** research director, Coop. Condensfadrick, Lunwaiden, Holland; **F. A. Robinson,** Eng.; **Otto Hogl,** chief of food control, Swiss Board of Public Hygia, Berne; **Yusuke Sumiki,** University of Tokyo; **W. A. M. Voss,** William Voss and Co., Waalwijk, Holland; **J. Roelofs Hyermans,** director, Leather Institute, T and O, Tilburg, Holland; **Clemens Schoepf,** Technische Hochschule Darmstadt, Darmstadt, Germany.

Grants and Fellowships

The **American Society for Metals** has established three annual $2,000 awards for teachers of metallurgy in the U. S. or Canada whose "performance and influence upon the general progress of the profession are judged best" by a special committee appointed by the society's Board of Trustees. Candidates must be under 40 years of age on April 1 of the year during which the award will be made.

Applications for **Atomic Energy Commission Graduate Fellowships** in radiological physics must be in the hands of the Oak Ridge Institute of Nuclear Studies by *March 1, 1952.* Fellowships are awarded for study at the University of Rochester in cooperation with Brookhaven National Laboratory and at Vanderbilt University in cooperation with Oak Ridge National Laboratory. Annual basic stipend is $1,500 and appointments are for one year.

The **Bank of America–Giannini Foundation** will offer scholarships in medical research to qualified U. S. citizens who apply through any of the accredited California medical schools. Further information may be obtained from the foundation at 300 Montgomery St., San Francisco.

The **William W. Coleman Scholarship Fund** has been established at Lehigh University for students in metallurgical engineering by William W. Coleman, chairman of the board of Bucyrus-Erie Corporation and 1895 graduate of Lehigh.

In its annual report for the year ended June 30, 1951, the **Commonwealth Fund** detailed gifts of $1,008,242.50, out of total appropriations of $2,879,383.99 for the year, for medical education. During the year the Fund made grants to seven institutions: the largest, $344,725, went to the Cornell University Medical College for three years' support of a new clinic for comprehensive medical care in the outpatient department of the New York Hospital. This grant also continues partial support of a special clinic which is training teachers and conducting research in psychosomatic medicine. A sum of $264,912 went to the University of Colorado School of Medicine for the first three years of an experiment intended "to demonstrate the practice of good general medicine." Grants were made to the department of rehabilitation and physical medicine of the New York University College of Medicine; and to a medical-psychiatric teaching program at the University of Cincinnati College of Medicine; to a regional postgraduate educational service of the Medical College of Virginia and the University of Virginia. The Fund will contribute to the cost of training medical scientists for medical research at the Massachusetts Institute of Technology for the next five years, and is helping in the development of field training at the Harvard School of Public Health. Appropriations for experimental health services amounted to $679,471.84. Studies of schizophrenia by a combination of psychiatric, psychological, and physiological methods, carried on at Tulane Univer-

sity School of Medicine, were chief among 13 grants for medical research amounting altogether to $454,768.50. Advanced fellowships were awarded to 19 Americans. Eleven men and women from other countries had fellowships for professional training or observation here. The capital of the Fund has been increased to $81,000,000 through the termination of a trust established by Edward S. Harkness and by bequest from Mrs. Harkness, who also left the Fund her house at 1 East 75th St., New York.

The **National Multiple Sclerosis Society** has provided $15,000 for an investigation at the Foundation of Applied Research, San Antonio, of a possible virus origin of multiple sclerosis. The project will be under the direction of James R. M. Innes, a graduate of Edinburgh and Cambridge universities, and USPHS special research fellow in 1948–51.

Under an initial **Office of Naval Research** grant of $60,000, the Special Devices Center at the University of Rochester will investigate the design of equipment and instrument control in both military and industrial fields. Directed by S. D. Shirley Spragg, professor of psychology, an attempt will be made to build machines that will take into account the response characteristics of human beings.

In the Laboratories

The Borden Company has shifted the site of its proposed $600,000 resorcin-manufacturing plant from Tacoma, Wash., to Dominguez (Los Angeles County), Calif. The new plant, the first of its kind on the West Coast, will produce an estimated 1,000,000 pounds of technical grade resorcin annually, resin glues, and industrial resins. Eventually, it is expected that the plant will also produce molding compounds.

A Group on Transistors, appointed by the Research and Development Board, will assist its Committee on Electronics to establish sound policies for the development and functional application of transistors by the armed services. University and industrial laboratory representatives are J. W. McRae, Bell Telephone Laboratories, chairman; E. Finley Carter, Sylvania Electric Products; E. W. Engstrom, RCA Laboratories; I. A. Getting, Raytheon; A. G. Hill, MIT; and G. F. Metcalf, G-E. Six military representatives are also included in the group.

Lederle Laboratories Division of the American Cyanamid Company has appointed John T. McAndrew, Jr., of Jacksonville, Fla., as a chemist in the Pharmaceutical Section, and John A. Gorwich, of Muhlenberg College, as a biologist in the Chemical Section.

Parke, Davis & Company expects to start production in its new chloromycetin plant near Holland, Mich., by the end of the year. The world's first plant for the exclusive manufacture of an antibiotic by chemical means will be under the direction of D. J. Vink, and W. F. Roser will be manager of the chemical manufacturing department.

A Research and Engineering Command, with headquarters at Army Chemical Center, Md., has been formed to direct all research, development, and engineering activities of the Chemical Corps. William M. Creasy was named to head the new command and was also appointed commanding general of the center, thus becoming responsible for all research and development for the Department of the Army in toxicological warfare. Announcement has also been made that Henry M. Black has been made commanding general of the Materiel Command, which will soon be moved from the Chemical Center to Baltimore.

Sharpe & Dohme, Inc., has appointed two new research associates, Albert L. Brown, of Cornell, and Benjamin E. Sanders, of Henry Ford Hospital, Detroit.

Shell Chemical Corporation will add to its Houston facilities a unit for recovering sulfur from waste refinery gases, the output of which will be sold for conversion to sulfuric acid. Operation is expected by mid-1952.

Sias Laboratories, of Brooks Hospital, Brookline, Mass., has appointed Ernest H. Beutner research supervisor in charge of the microbiological program, and Arthur DeTore clinical chemist to supervise clinical laboratory work.

Miscellaneous

Sigmund Freud Archives, incorporated in the state of New York early this year, was organized by a group of psychoanalysts to obtain and preserve a complete compilation of Freud's writings, published and unpublished. Under an agreement with the Library of Congress, which will serve as curator, confidential material will be restricted on request of the donor. Anyone in possession of letters to or from Freud, as well as those who were personally acquainted with him, are asked to get in touch with the Archives at 575 Madison Ave., New York 22.

Technical assistance in fishery development under FAO has been extended to Ecuador, where E. C. Schweiger, of the Peruvian Guano Company, is preparing a plan for increasing the fisheries. A less detailed survey is being made in Brazil by C. J. Bottemane, of the Netherlands. Two other Netherlands experts, Arie van den Berg and H. van Pel, have been sent to Pakistan to advise the government on various problems. Alan Glanville, of England, is handling an assignment in Ceylon. S. Y. Lin, of China, has been working in Haiti since 1950, and S. W. Ling has been assigned to Thailand. Erik M. Poulsen and John Fridhjof, of Denmark are working in Chile. In addition, educational work is also in progress. In Chile a Fisheries Training Center will be in operation for ten weeks beginning in January 1952, which will draw some 50 South American students. Information about positions in the program may be obtained from the Fisheries Division, FAO, Viale delle Terme di Caracalla, Rome.

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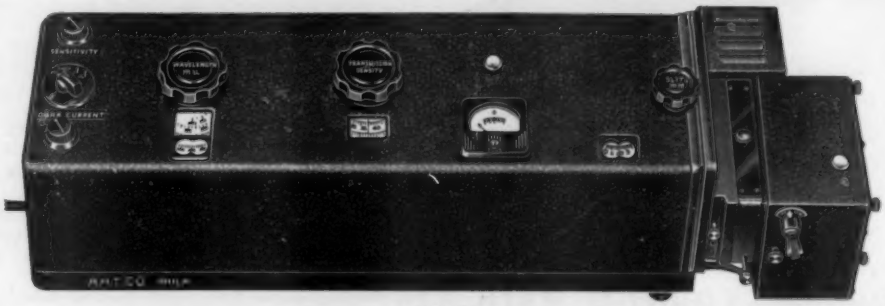

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Publications Received

Annual Report of the Board of Regents of the Smithsonian Institution, Publ. 4025. Showing the operations, expenditures, and condition of the institution for the year ended June 30, 1950. Washington, D. C.: Supt. Documents, GPO, 1950. 522 pp. $3.00.

Application of Linear Programming to the Theory of the Firm. Including an analysis of monopolistic firms by nonlinear programming. Robert Dorfman. Berkeley: Univ. California Press, 1951. 98 pp. $3.50.

The Application of Scientific Methods to Industrial and Service Medicine. Proc. Conf. March 29–31, 1950. London: H. M. Stationery Office, 1951. 3 s.

British Scientists. E. J. Holmyard. New York: Philosophical Library, 1951. 88 pp. $2.75.

Calculus. Rev. ed. Joseph Vance McKelvey. New York: Macmillan, 1951. 405 pp. $4.50.

Design, Construction and Operating Principles of Electromagnets for Attracting Copper, Aluminum and Other Non-Ferrous Metals. Leonard R. Crow. Vincennes, Ind.: Scientific Book Pub., 1951.

The Development of Tests for Evaluating Research Proficiency in Physics and Chemistry. (Fourth in a series of reports prepared under the sponsorship of the Manpower Branch, Human Resources Div., ONR). Mary H. Weislogel. Pittsburgh: Am. Inst. for Research, April 1951.

Elements of Plant Protection. Louis L. Pyenson. New York: Wiley; London: Chapman & Hall, 1951. 538 pp. $4.96.

Fauna of Upper Vale and Choza: 1–5. Everett Claire Olson. Aug. 28, 1951. 60¢. ***A New Ranid Frog*** (Staurois) ***from the Colony of Hongkong.*** Clifford H. Pope and J. D. Romer. Sept. 5, 1951. 10¢. ***Non-Marine Shells from Borneo, Collected by the Borneo Zoological Expedition, 1950.*** Fritz Haas. Sept. 5, 1951. 15¢. ***Notes on some Peruvian Birds.*** Melvin A. Traylor, Jr. Sept. 5, 1951. 10¢. ***New Species and New Records of Fishes from Bermuda.*** Loren P. Woods and Robert H. Kanazawa. Chicago: Chicago Natural History Museum, Sept. 14, 1951. 20¢.

Fisher Gas-Analysis Manual. Rev. ed. Maryan P. Matuszak. Pittsburgh: Fisher Scientific Co.

High Frequency Transmission Lines. 3rd ed. Willis Jackson. London: Methuen; New York: Wiley, 1951. 152 pp. $1.75.

A Hundred Years of Psychology. 2nd ed. J. C. Flugel. London: Duckworth; New York: Macmillan, 1951. 424 pp. $3.25.

How to Know the American Mammals. Ivan T. Sanderson. Boston: Little, Brown, 1951. 164 pp. and plates. $2.50.

Inventory of Research in the Social Sciences at the University of Minnesota, 1949–50. Minneapolis: Social Science Research Center, Univ. Minnesota, Feb. 1951.

Laboratory Manual for General Zoology. 2nd ed. Tracy I. Storer. New York–London: McGraw-Hill, 1951. 150 pp. $2.50.

Magnetic Results from Huancayo Observatory, Peru, Vol. X-C, No. 175. Dept. Terrestrial Magnetism, Carnegie Institution of Washington, January 1945–June 1947; Instituto Geofisico de Huancayo, July–December 1947. P. G. Ledig *et al.* Washington, D. C.: Carnegie Institution of Washington, 1951. 120 tables and text. $.75 paper, $1.50 cloth.

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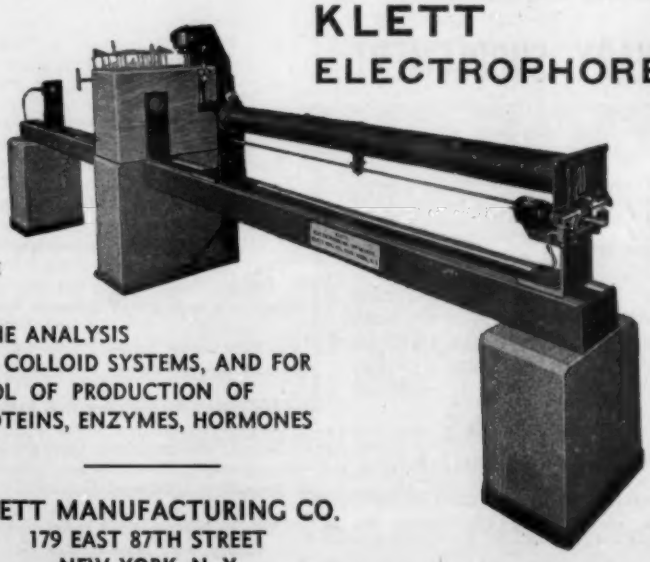

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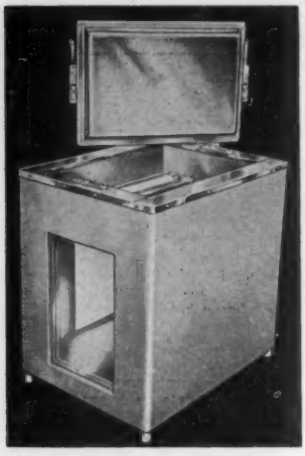

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Meetings & Conferences

Dec. 5–8. Philippine College of Surgeons (Annual). Philippine General Hospital, Manila.

Dec. 6. American Psychoanalytic Association (Midwinter). Hotel Waldorf-Astoria, New York.

Dec. 6. Society of Cosmetic Chemists (Annual). Biltmore Hotel, New York.

Dec. 6–8. American Chemical Society (Southwest Regional). Austin, Texas.

Dec. 7–8. Way of Science Conference (Annual). Roosevelt College, Chicago.

Dec. 8–13. American Academy of Dermatology and Syphilology (Annual). Palmer House, Chicago.

Dec. 9–13. Entomological Society of America, American Phytopathological Society, and the Potato Association. Netherland Plaza Hotel, Cincinnati.

Dec. 10. Human Rights Day.

Dec. 10–11. Southern Psychiatric Association (Annual). Carolina Inn, Pinehurst, N. C.

Dec. 11–13. North Central Weed Control Conference (Annual). Municipal Auditorium, Oklahoma City.

Dec. 11–19. International Congress on Mental Health. Mexico City, D. F.

Dec. 14–15. Association for Research in Nervous and Mental Disease. Roosevelt Hotel, New York.

Dec. 20. American Society of Perfumers. Advertising Club, New York.

Dec. 26–28. American Mathematical Society. Brown University, Providence, R. I.

Dec. 26–31. AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Philadelphia.

Dec. 27–28. American Chemical Society (Division of Industrial and Engineering Chemistry, Christmas Symposium). Evanston, Ill.

Dec. 27–29. American Physical Society. University of California, Berkeley.

Dec. 27–30. National Science Teachers Association (Annual). Philadelphia.

Dec. 27–Jan. 2. Institute of General Semantics Seminar (Winter). Lime Rock Lodge, Lakeville, Conn.

Dec. 28–29. American Speech and Hearing Association. New York.

Dec. 29. The Mathematical Association of America (Annual). Brown University, Providence, R. I.

Jan. 7. Massachusetts Society for Research in Psychiatry. Ring's Sanitorium, Arlington.

Jan. 7–8. American Institute of Electrical Engineers Conference on Electronic Instrumentation and Nucleonics in Medicine. Commodore Hotel, New York.

Jan. 14–18. Society of Automotive Engineers (Annual). Hotel Book-Cadillac, Detroit.

Jan. 15–18. Highway Research Board (Annual). National Academy of Sciences and National Research Council, Washington, D. C.

Jan. 16–18. Society of Plastics Engineers (Annual). Chicago.

Jan. 21–22. Compressed Gas Association (Annual). Waldorf-Astoria, New York.

Jan. 21–25. American Institute of Electrical Engineers (Winter). Hotel Statler, New York.

Jan. 23–24. National Industrial Conference Board (General—all associates). Waldorf-Astoria, New York.

Jan. 26. Metropolitan Detroit Science Club, Wayne University, and Institute for Economic Education. Institute and Industrial Exhibits on "Jobs Open to Science Trained High School Graduates." Wayne University, Detroit.

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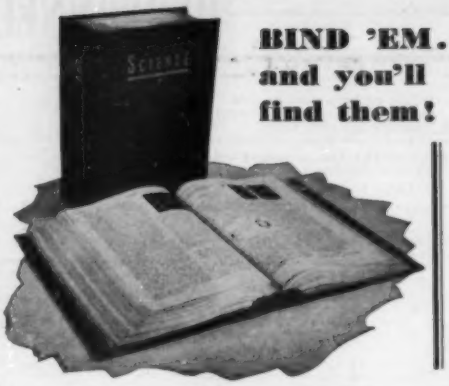

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118th AAAS MEETING

Philadelphia, December 26-31, 1951

The list of hotels and the reservation coupon below are for your convenience in making your hotel room reservation in Philadelphia. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Philadelphia and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **Share a room with a colleague if you wish to keep down expenses.** Mail your application *now* to secure your first choice of desired accommodations.

HOTELS AND RATES PER DAY

Hotel★	Single	Double	Twin-Bedded	Suites
ADELPHIA★	$5.00–$6.00	$7.50–$10.50	$10.00–$12.50	$25.00–$35.00
BARCLAY			$ 8.00–$12.00	$14.00–$25.00
BELLEVUE–STRATFORD★	$4.50–$6.00	$8.00–$10.00	$ 9.00–$12.00	$20.00–$30.00
BENJAMIN FRANKLIN★	$5.00–$7.50	$8.00–$10.50	$11.00–$13.00	$18.00
DRAKE	$6.00	$ 7.00	$ 9.00	$15.00
ESSEX	$4.75–$5.00	$6.00–$ 8.50	$ 9.00–$10.00	
JOHN BARTRAM★	$3.25–$4.50	$5.00–$ 8.00	$ 7.00–$ 9.00	
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SYLVANIA★			$ 9.00–$11.00	$18.00
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Cots added to a room are $2.50 each; dormitory style rooms (for 5 or more) are $3.50 per person.

★ Hotels starred have sessions in their public rooms. For a list of the headquarters of each participating society and section, please see Association Affairs, *Science*, August 24, or *The Scientific Monthly*, September.

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AAAS Housing Bureau
Architects Building (1st Floor)
Philadelphia 3, Pa.

Date of Application .....

Please reserve the following accommodations for the 118th Meeting of the AAAS:

TYPE OF ACCOMMODATION DESIRED

...Single Room(s) Desired Rate ..... Maximum Rate .....

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..... (*Enumerate persons here and attach list giving name and address of each person, including yourself*)

CHOICE OF HOTEL

First Choice ..... Second Choice ..... Third Choice .....

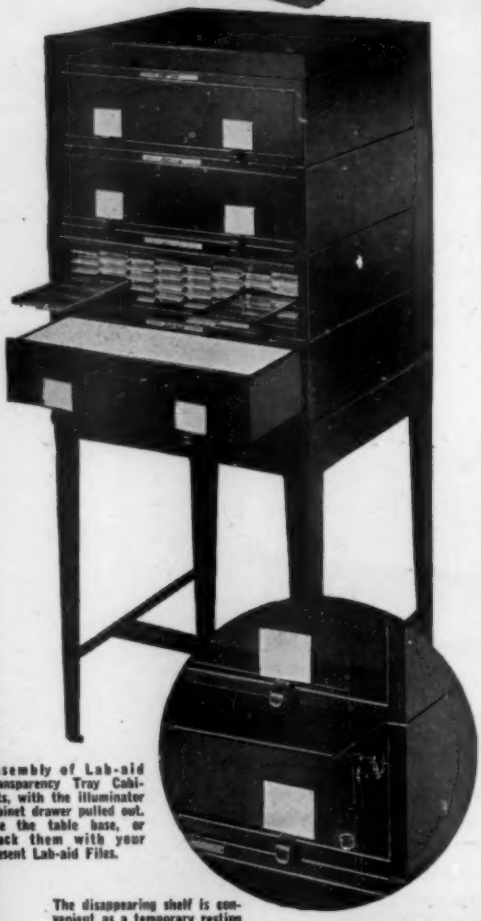
DATE OF ARRIVAL ..... DEPARTURE DATE .....
(These *must* be indicated)

NAME .....
(Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

Mail this now to the Housing Bureau. **Rooms will be assigned and confirmed in order of receipt of reservation.**

the new *Lab-aid* way to store and view color transparencies



Assembly of Lab-aid Transparency Tray Cabinets, with the illuminator cabinet drawer pulled out. Use the table base, or stack them with your present Lab-aid Files.

You know how efficiently Technicon Lab-aid cabinets bring order to the filing of microslides, paraffin blocks and associated materials in the pathologic laboratory.

Now, in this new addition to the Lab-aid Filing System, you can enjoy the same benefits in the filing and viewing of color transparencies and lantern slides. The new Lab-aid transparency file has 40 smooth-sliding flat trays, each holding 16 standard 2" mounts, or 5 3¼" x 4¼" lantern slides in full view. They're easy to insert . . . you just drop them flat in the grooved frames. Easy to remove, too, by popping them out from underneath.

The special cabinet with its pull-out illuminator drawer lets you view a whole tray of transparencies at a glance, without removing any of them. Sitting or standing, you can inspect hundreds of slides under ideal viewing conditions without stirring from your place. And the disappearing shelf is a mighty handy place to lay slides down temporarily while you're working with them.

Both tray and illuminator cabinets are of the same dimensions and finish as all the other units in the Technicon Laboratory Filing System, and can be stacked interchangeably with them. If you would like more information about these or other units of the system, we'll be glad to send details.

The disappearing shelf is convenient as a temporary resting place for slides while working with them.

Inspect all your slides without removing any of them, or even stirring from your place.

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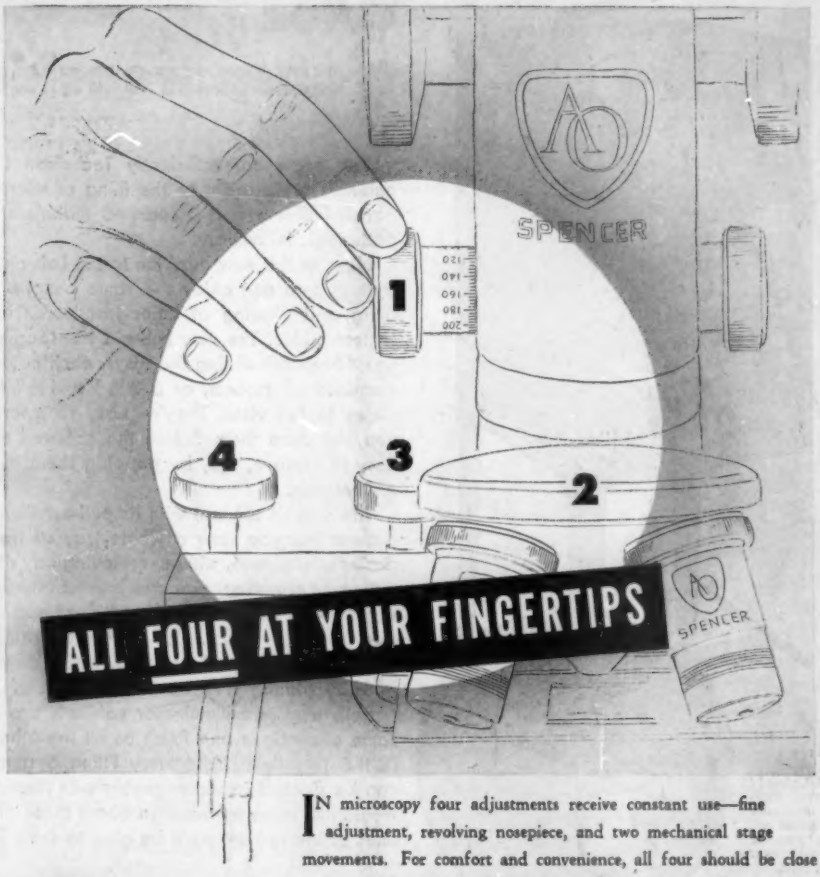

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